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SOIL STABILIZATION—

After C. A. Hogentogler

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A SHORT COURSE

Based on Exhibit of U. S. Bureau of Public Roads Displayed at the Recent Road Show

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Publishing Director, ROADS AND STREETS

PART I

This Short Course is based on the panel exhibits of the U. S. Bureau of Public Roads on Soil Stabilization.

It is divided into two main headings:

1. *The stabilization of soils used in road surfaces and foundations.*
2. *The methods used for determining the supporting power of soil foundations for bridge piers, abutments, and cofferdams.*

The course will extend over six or seven issues. The writer wishes to make quite clear that this Short Course is a presentation of Mr. Hogentogler's work. The writer has merely introduced explanatory paragraphs in places along with extracts of reports by Mr. Hogentogler and others.

STABILIZATION of soil for road and street surfaces, bases and foundations is yet in the experimental stages of development. However, a great deal of useful information has been developed, and the first time to the writer's knowledge that this information has been logically correlated in a sequential presentation was at the last Road Show exhibit of the engineers of the U. S. Bureau of Public Roads.

In the writer's travels about the country (he covered 35,000 miles last year) talking with engineers, contractors, and public officials, he has observed a notable lack of definite understanding of road stabilization. There is much loose talk and loose thinking on the subject. Too often practical construction is not correlated to the theory of soil stabilization. In an endeavor to help clarify the subject, to help disseminate the theory of soil stabilization, the writer has prepared this series of articles.

First of all, let us get firmly fixed in our minds that soil stabilization for road building is not a panacea. It is merely one class of road and street construction out of the economically justifiable series of constructions that may be employed. A road to be improved should be studied from its traffic, social, and economic points of view before a figure is established as to how much money can or should be spent in constructing it. If funds are available to build a good bituminous plant-mix or road-mix job with properly graded aggregates or a good concrete road and such construction can be justified on the bases established for rendering judgment, there is no reason to try to construct a stabilized soil road. On the other hand there are hundreds of thousands of miles of roads and streets on which soil stabilization construction can be economically justified and, in fact, must be employed if a decision has been made to improve the road.

Let us start with a definition: Soil Stabilization (after Mr. C. A. Hogentogler)—"The process of giving natural soils enough abrasive resistance and shear strength to accommodate traffic or loads under prevalent weather conditions, without detrimental deformation. The methods employed include the use of admixtures, compaction, and densification by specific technical theory and laboratory control. Optimum water content is fundamental with gradation. Admixtures may be soil materials, deliquescent chemicals, solutions of electrolytes, soluble cementitious chemicals, primes and neutralizers, and insoluble binders." This definition was taken from the

new book ENGINEERING TERMINOLOGY, by Brown and Runner.

The essential features of stabilization include prevention of clay, silt, and loamy soils from becoming detrimentally wet, incorporation of granular materials in clay soils, furnishing granular soils with cohesive binder, or a combination of one or more of these. General methods for accomplishing stabilization may be enumerated as follows:

1. Selection of natural soils with granular materials and binder which furnishes high stability.

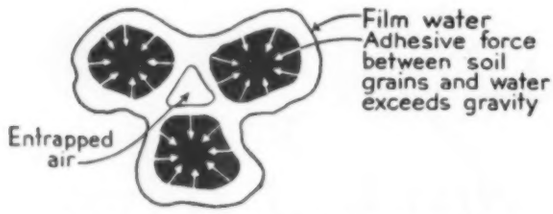

Fig 1.—Film Water Adsorbed on Soil Grains

2. Adding soil binder to granular materials, or adding granular material to clays.
3. Treating graded soils with deliquescent materials.
4. Waterproofing soils with bituminous materials.
5. Combinations of 1 or 2 and 3, or, 1 or 2 and 4.
6. Densification of natural soils by special manipulation in combination with admixtures of physical or chemical materials other than soil to eliminate permanently those colloidal and clay properties productive of volume change.

Economics of the local conditions will dictate which method should be used. Comprehension of the practicability of permanently densifying soils is facilitated by understanding the performance of materials when surrounded by films of molecular thickness. The theory of matter in the film phase, the wetting of solids by liquids, absorption as affected by electrolytic properties, and the densification of soil at optimum moisture content all enter into a complete understanding of soil stabilization. At present we do not have complete information on soils with which to prepare exact formulae. Until we can definitely assign values to constants in equations and evalute the variables, we must depend upon empirical formulae for design. Soil stabilization design practice is passing through this stage of development.

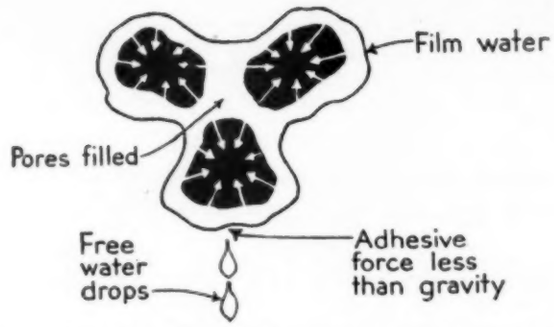

Fig. 2.—Free Water Fills Pores of Soil Grains and Flows Away

WATER

SHRINKAGE AND SWELL MUST BE CONTROLLED IF A SOIL IS TO HAVE PROPER STABILITY FOR USE IN ROAD BUILDING

There are two kinds of soil moisture:

1. Film or capillary water
2. Free water

Film or capillary water is that which adheres to the surface of the soil grains and is not removed by the force of gravity. This is pictured in Fig. 1. Powerful centrifuges exerting pulls of hundreds of thousands of pounds fail to remove film moisture which is more adhesive, or gluelike, than ordinary water.

Free water, as indicated by Fig. 2, is drained away by the force of gravity. One of our early road builders made the following statement: "There are five fundamentals to good road construction. The first is drainage; the second is Drainage; the third is DRAINAGE; the fourth is line; and the fifth is grade." All too often we neglect drainage as it is involved in its many and varied forms.

Film or capillary water is adsorbed in various molecular thicknesses, which explains why some soils are more plastic than others. Adhering films are more gluelike than dripping water and their thicknesses vary widely on different kinds of soil particles.

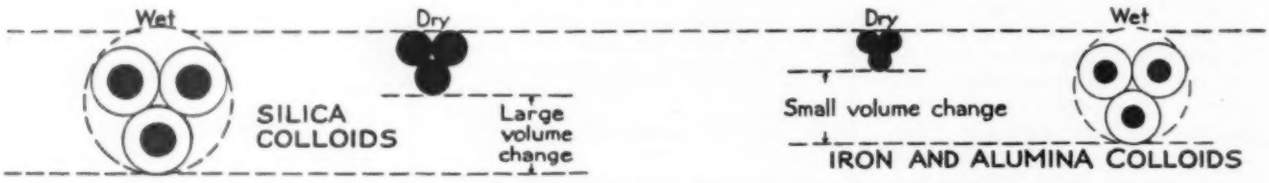

Fig. 3—Showing Influence of Chemical Composition on Water Film Thickness.

Two factors control the thickness of moisture films:

1. Chemical composition
2. Effect of ions

Colloids high in silica adsorb thick films and their volume undergoes great changes upon wetting and drying. Fig. 3 shows this property pictorially. Iron and alumina colloids adsorb thin films of moisture and, therefore, undergo little volume change upon wetting and drying.

The effect of ions is two-fold. First, like colloids, these electrified particles, depending upon the material of which they are composed adsorb water films of varying thicknesses. At one end of the metallic scale we have the potassium ion which holds only 16 molecules of associated water. At the other end is the lithium ion which

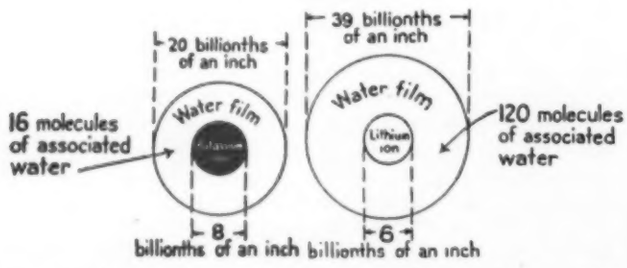
20 billionths of an inch
39 billionths of an inch
16 molecules of associated water
Water film
Water film
120 molecules of associated water
8 billionths of an inch
6 billionths of an inch

Fig. 4—Showing Influence of Effect of Ions on Water Film Thickness

holds 120 molecules of associated water. This is shown pictorially in Fig. 4. Other metallic ions depending upon the number of molecules of associated water occupy relative positions between potassium and lithium. Second, these water-film coated ions in turn ionize a soil colloid. The character of the ion determines the thickness of the water film on the soil colloid. In nature we do not find clay alone but instead—hydrogen clays, iron clays, calcium clays, etc. This means that the clay particles have their surfaces coated with ions of hydrogen, iron, calcium, etc. *The clay particle thus becomes endowed with the swell, shrinkage, and plasticity of the several ions.* Therefore:

1. Potassium clay becomes the most stable and lithium clay the most unstable.
2. Change of ions alters the shrinkage, swell, and plasticity of the soil so as to improve stability when the change is made toward the potassium ion by other metallic ions.

Variation in stability of road soils results from shrinkage and swell of the soils, and this depends upon the changes in thickness the films undergo with changing weather conditions.

The principal aims in soil stabilization then, are (1) to make the soil as dense as possible, and (2) to prevent

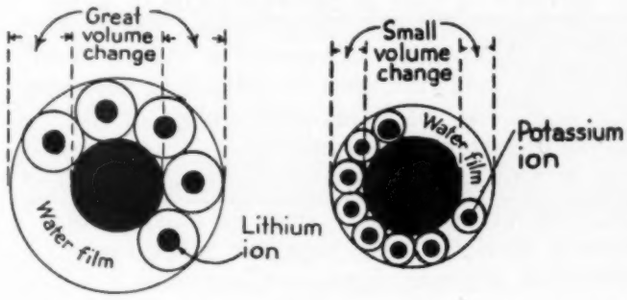

Fig. 5.—Pictorial Representation of Ionization of Clay Particles.

the thicknesses of the resulting adhesive films from changing once the optimum water content has been attained. Water film alone may have sufficient strength to hold soil particles together, but with changing weather conditions their volumes are likely to change. To control as nearly as possible any fluctuation from the optimum water content, hence film volume, therefore, we turn to admixtures or mechanical arrangement. Chemical solutions and insoluble binders are used and only those selected which add to or substitute for, moisture film strengths.

One of the first pioneers to recognize the value of certain top-soils and clay-gravels, in the southeastern United States, for road surfaces, Dr. C. M. Strahan, found that the best natural deposits made firm and hard road surfaces, were free from mud and excessive dust, and were capable of supporting the heaviest loads after long rains, and of carrying traffic in both wet and dry weather without undue injury.

INGREDIENTS

Subgrade Soils for Maximum Stability Must Have the Proper Proportions of Aggregate and Soil Binder

Aggregates are classified under three headings:

1. Gravel, stone, or slag. The largest particles vary in diameter from 2 inches to 1/10 of an inch.
2. Sand, or similar granular material, next largest in size ranges in diameter from 1/10 to 2/1000 of an inch.
3. Silt, or other pulverized rock, varies in diameter from 2/1000 to 2/10,000 of an inch.

Figure 6 is a pictorial representation of the base mixture. It must be remembered that design of base mixtures must differ from design of stabilized soils where the soil is a road surface. Some aggregates, such as limestone and slag, may be soluble enough when wet so that on their surfaces a gelatinous cement will form

Fig. 6.—Showing Texture of Stabilized Base Course.

Fig. 7.—Aggregate Bound by Dried Soluble Mineral.

which, after drying, binds the particles together. This is shown pictorially in Fig. 7. Study of various mixtures has indicated the following:

1. Soluble aggregates, properly graded and treated chemically, become highly stable under traffic.
2. Calcium and sodium chlorides increase the solubility of soluble rocks and provide more gelatinous cement to bind the particles into a stable mass.
3. Certain insoluble granites become unstable unless improved with a small amount of soluble rock powder.

Many clays are to some extent soluble and subject to disintegration in the presence of water. When mixed in the proper proportion with aggregates they form the soil binder. Clay, which includes colloidal materials, consists of particles of 2/10,000 of an inch in diameter and smaller. Colloids are particles of 4/100,000 of an inch in diameter and smaller. The soil binder differs from the aggregate in that the grain sizes represent clusters rather than single soil particles, as shown in Fig. 8. Both clays and colloids are the products of the chemical action of decomposition, weathering, plant growth and decay, and consequently may differ consid-

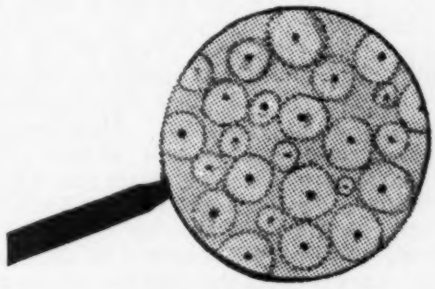

Fig. 8.—Soil Binder.

erably in chemical composition from their parent rocks. The soil clusters of clays and colloids may be changed by:

1. Agitation in water.
2. Manipulation of the soil.
3. Chemical or electrical treatment.

From this discussion we conclude that the *clay* and *colloid* fractions have properties which are *variable* as compared to the constant properties of the aggregates.

Every particle of aggregate and soil binder is electrically charged. Test data of the work done by Dr. Hans Winterkorn showed that the physical character of natural soils, especially as pertaining to stability at varying moisture contents, can be changed to a great extent by a change of the adsorbed ions. As stated above, clay and colloid fractions have properties which are variable, so in defining clays they must not only be defined as to size and chemical composition but as to shape and electrical structure as well. These electrical forces are small and operate measurably, only in solutions; what may happen over a period of time is as yet undetermined. This is the reason why some engineers advocate the preparation of a clay slurry before incorporation with aggregates. Effects of electrical forces are shown by Fig. 9. An example of proportioning procedure and tests for actual construction practice will appear later.

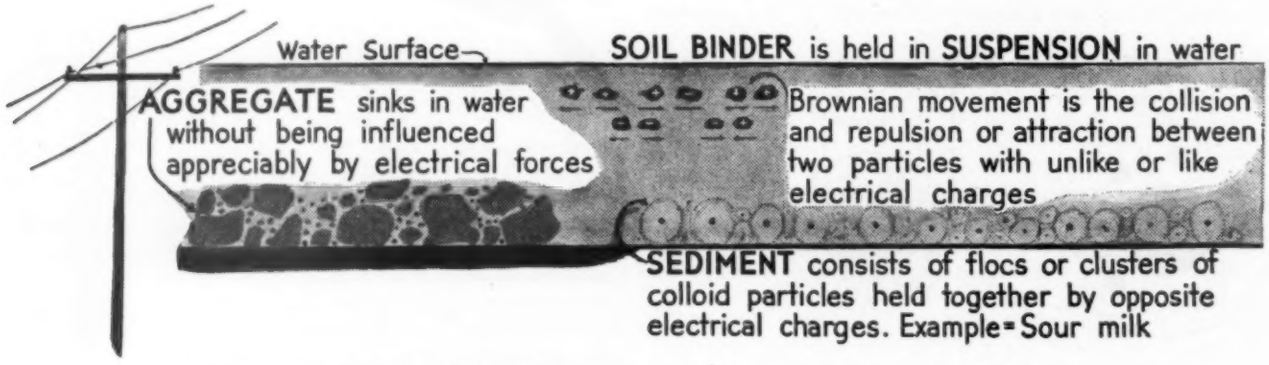
Water Surface
SOIL BINDER is held in SUSPENSION in water
AGGREGATE sinks in water without being influenced appreciably by electrical forces
Brownian movement is the collision and repulsion or attraction between two particles with unlike or like electrical charges
SEDIMENT consists of flocs or clusters of colloid particles held together by opposite electrical charges. Example = Sour milk

Fig. 9.—Showing Effect of Electrical Forces in Solutions of Aggregate and Soil Binder.

Density of a Compacted Soil Depends Upon the Thickness of the Moisture Films Surrounding the Soil Particles

The full line curve, Fig. 10, obtained by compacting samples of a particular soil at different moisture contents with equal pressures, shows four distinct stages of wetting before the pores of the soil become completely filled with water. At any density, the moisture content shown between the solid and broken lines represents the percentage by volume, required to replace the contained air.

Up to 20.7 per cent moisture the soil is damp and the moisture films are highly cohesive but have sufficient friction to prevent high density. From 20.7 to 31.1 per cent moisture, the soil reaches maximum density. In this range the moisture films have less cementing value but greater lubricating properties. Therefore the soil particles can be made, mechanically, to slide past each other and to be adjusted so as to obtain greatest density, excluding all but a small amount of air. From 31.1 to 47.7 per cent moisture, swell occurs, but stability and density drop. The sample is wet. At 47.7 per cent equilibrium occurs between the attraction of the soil particles for each other and of gravity for the moisture. Above 47.7 per cent moisture, water gradually replaces the air content until at 54.3 per cent moisture, the soil becomes completely saturated. The slope of the density—moisture content relation within the swell range, Fig. 10, depends primarily on the specific gravity of the soil particles and hence is fairly constant. Soils with the greatest ranges of moisture contents in the swell stage are likely to swell most.

Slopes of the density-moisture content relation, in the lubrication stage, approximately equal to, although opposite in sign from, those in the swell stage, indicate soils whose designed densities can be most easily attained during construction. Attainment of designed density becomes the more difficult and laborious as the slope of the density-moisture content curve, within the lubrication stage, becomes steeper. Soils with maximum density are likely to have maximum stability under changing weather conditions.

Relation Between Density, Moisture Content, and Stability.—In the typical diagram, Fig. 11, stability drops off rapidly as moisture contents are increased above the optimum and vice versa. At every density less than the maximum there is a moisture content (1) below the optimum at A, corresponding to one (2) above the optimum at B, which the wet soil can attain without changing volume; but—the corresponding stability at *A is* 1900, and at *B is only* 270 pounds per square inch. Thus, for the same dry weight density (108 lb. per cu. ft.) the moisture content may be either 13.7 per cent (indicated stability 1900 lb. per sq. in.) or 19.3 per cent (indicated stability 270 lb. per sq. in.).

The Proctor compaction tests serve excellently as a

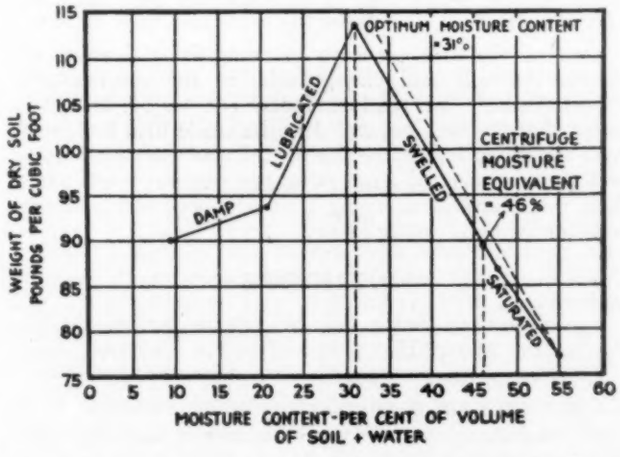

Fig. 10.—Density-Moisture Content Relationship.

means to determine the proportions in which an aggregate (referring to the fine aggregates) and binder soil may be combined in order to provide maximum density. The plasticity index of the mixture thus indicated then becomes a useful tool for control during construction.

The left-hand curve in Fig. 11 shows that for each soil there is an optimum moisture content at which maximum density can be obtained. The right-hand curve shows the stability of samples compacted at different moisture contents. For the sample represented by these data, the optimum moisture content is about 16.5 per cent, the maximum density, 111.8 lb. per cu. ft., and the

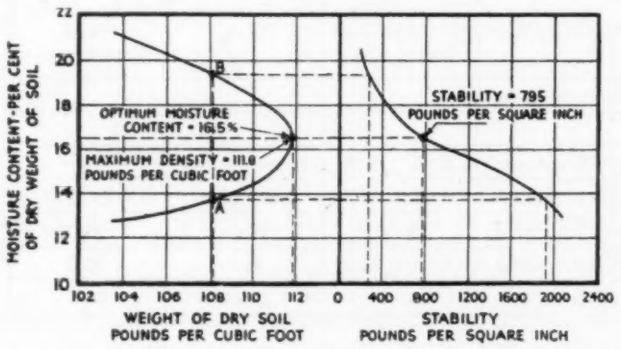
MOISTURE CONTENT-PER CENT OF DRY WEIGHT OF SOIL
OPTIMUM MOISTURE CONTENT = 16.5%
MAXIMUM DENSITY = 111.8 POUNDS PER CUBIC FOOT
STABILITY = 795 POUNDS PER SQUARE INCH
WEIGHT OF DRY SOIL POUNDS PER CUBIC FOOT
STABILITY POUNDS PER SQUARE INCH

Fig. 11.—Density, Moisture Content, and Stability Relationships.

corresponding stability, 795 lb. per sq. in. Laboratory determination of these factors follows a practice that has been arbitrarily established or standardized. Laboratory methods and equipment will be discussed later.

Suitability of Soils for Fill Construction Depends Upon the Density to Which They May Be Compacted.—The relations of the optimum moisture contents to pressure, density and stability shown in Fig. 12, are the control data for use in embankment construction. For the compactive pressure to be provided by a given type of equipment the corresponding optimum moisture content, resulting density, and plasticity needle readings are shown by the curves. Likewise for any desired embankment density, the equivalent pressure which must be furnished by the rolling equipment is disclosed.

To illustrate, let it be assumed that the Proctor equipment, exerting a compactive effort equivalent to 300 lb. static pressure, is to be used. Then the soil, Fig. 12, should be compacted at a moisture content of 38.2 per cent (22.9 per cent by weight of dried soil); the result-

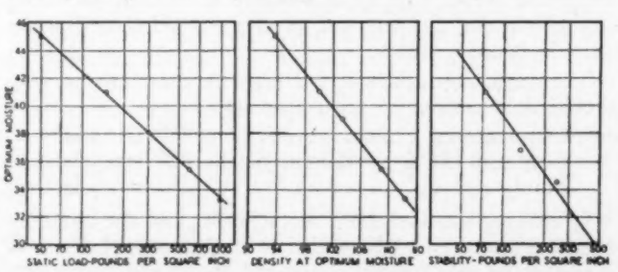

Fig. 12.—Control Curves, Sample A.

ing density should be 104.4 lb. per cu. ft., and the plasticity needle reading, 117 lb. per sq. in.

If, on the other hand, the embankment is to be constructed at an optimum moisture content equal to, say the plastic limit (41.4 per cent by volume), the soil should be compacted at an equivalent of 130 lb. per sq. in. static pressure. The resulting density is 99.2 lb. per cu. ft., and the plasticity needle reading, 69 lb. per sq. in.

This explanatory discussion is taken from a paper on "Essentials of Soil Compaction" by C. A. Hogentogler, Jr., which appeared in the 1936 Proceedings of the Highway Research Board.

As stated before, the chemical composition of the soil particles, the kind of ions adsorbed on their surfaces, and admixtures having electro-chemical properties influence the thickness of adhesive films and therefore affect the density to which soils may be compacted.

It is well known that soils with a relatively high silica content are not likely to become so dense under equal pressures as those composed principally of iron and alumina; that at equal pressures clays saturated with lithium ions are likely to have higher moisture contents than soils saturated with potassium ions; and that road soil mixtures containing calcium chloride, for example, become denser under traffic than similar soil mixtures without this electrolyte.

The control curves, Fig. 13, illustrate how they may serve to explain these phenomena. The full lines were furnished by tests of one kind of soil, A, and the broken lines by tests of the same soil treated with calcium chlo-

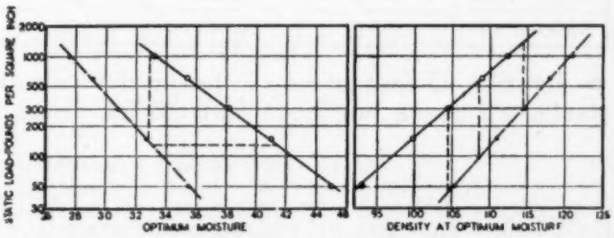

Fig. 13.—Control Curves, A and B.

ride, B. The curves at the left show that at the same pressure, 135 lb. per sq. in., the optimum moisture content of soil A is 41.2 per cent as compared with only 33 per cent for soil B; also that to have the same optimum moisture content of 33.0 per cent, soil A requires a pressure of 1,100 lb. per sq. in. and soil B a pressure of only 135 lb. per sq. in.

The curves to the right, Fig. 13, show that to attain the same density of 104.4 lb. per cu. ft., a pressure of 300 lb. per sq. in. is required for sample A as compared with 42 lb. per sq. in. for sample B; and that the same pressure of 300 lb. per sq. in. on soil A attains a density of 104.4 lb. per cu. ft. as compared with 114.5 lb. per cu. ft. of soil B.

Such control curves may serve in the same manner to disclose the effect of changing the acidity or alkalinity of soils or otherwise changing the metallic ions with which the soils may be saturated; also the effect of changing the electrical fields around the particles by means of treatment with electrolyte solutions.

Hydration (damp), lubrication, swell, and saturation limits as indicated by both the density and the stability curves agree within the range of experimental error (1½ per cent moisture content, maximum). This demonstrates that they truly disclose the end moisture contents of definite and specific phases of soil performance. Therefore, they become a tool for use in the intelligent selection of soils in all cases where compaction is a factor.

For information on the types of soils included in the gradings (A1, A2, A3, etc.) shown in the table see "Engineering Terminology" by Brown and Runner.*

*"Engineering Terminology"—Definitions of Technical Words and Phrases—by Brown and Runner. Published by Gillette Publishing Co., 865 Daily News Building, Chicago, Illinois.

Other definitions of technical terms used herein will also be found in this new book.

Example of Stabilized Base Design Without Admixture.—Sand-clay mortars of stabilized soil roads may be designed on the basis of either the plasticity index or compaction test data. The first step with either method is to determine the amounts and qualities of materials available in borrow pits and existing road surface by a soil survey and laboratory tests.

In the plasticity index method, the borrow pit clay soil, in different amounts, is added to the road surface or sandy soil (in some cases this process must be reversed) and the fractions of the soils and the mixtures passing the No. 40 sieve are tested. The plasticity indexes of the clay, the sandy soil and the mixtures are then plotted with respect to the portions of the two materials, as shown in Fig. 15.

If 800 cu. yds. of material, with a plasticity index of 4 are needed for a proposed section of road and there are only 350 cu. yds. with a P.I. of 2 available in the old road surface, then 450 cu. yds. of borrow pit soil with a P.I. high enough to give the desired resultant P.I. of 4, must be added. The plasticity index (P.I.) of the new material is determined by a method suggested in *Public Roads,* Feb., 1935, Fig. 3, to the effect that the plasticity index of any mixture of two soils, A and B, is expressed by the formula:

$$PI_m = PI_A + P_B \times (PI_B - PI_A)$$

in which PI_m = plasticity index of the mixture,
PI_A = plasticity index of the less plastic of the two soils,
P_B = fraction of the more plastic soil B in the mixture,
PI_B = plasticity index of soil B

By substitution of numerical values the plasticity index of the new material is found to be

$$4 = 2 + \frac{450}{800} \times (PI_B - 2)$$

$$PI_B = \frac{2500}{450} = 5.6$$

From the curve, Fig. 15, a mixture of borrow pit sand-clay containing 51 per cent of clay should have the required plasticity index.

The resulting mixture for use in the new surface should then consist of the following:

Old material .....350 cu. yds.
Clay soil (51% of 450 cu. yds.)..229 cu. yds.
Sandy soil .....221 cu. yds.

In making the analysis a record is kept of the amounts of water required to be added to obtain proper P.I. It is converted into quantity required for the final mixture and added during construction compaction. However, the compaction tests and determination of optimum water content for maximum density must be made and considered in connection with the quantities calculated from P.I. determinations. Compaction tests serve more definitely to indicate the best proportioning of several materials. They are essential when stabilizing soil with chemicals, bituminous materials, portland cement, or other admixtures.

(*To be continued*)

HEIGHT OF FILLS							
10 FEET OR LESS *				MORE THAN 10 FEET			
Maximum Dry Weight	Approximate Bureau Public Roads Classification	Rating	Maximum Field Compaction Requirements	Maximum Dry Weight	Approximate Bureau Public Roads Classification	Rating	Maximum Field Compaction Requirements
Pounds per cubic foot			Per cent of Dry Weight	Pounds per cubic foot			
89.9 and less	A-5, A-8	Unsatisfactory	----				
90.0 - 99.9	A-5, A-8	Very poor	95	99.9 and less	A-5, A-8	Unsatisfactory	----
100.0 - 109.9	A-6, A-7	Poor	95	100.0 - 109.9	A-6, A-7	Very poor	100.0
110.0 - 119.9	A-4	Fair	90	110.0 - 119.9	A-4	Poor	95.0
120.0 - 129.9	A-3, A-2	Good	90	120.0 - 129.9	A-3, A-2	Fair	90.0
130.0 and more	A-1	Excellent	90	130.0 and more	A-1	Good	90.0

* For fills 10 feet or less in height the soils should have liquid limits (L.L.) not greater than 65 and plasticity indexes not less than 0.6 L.L. minus 9.0

Fig. 14.—Table Showing Compaction Percentage Required for Various Soil Types.

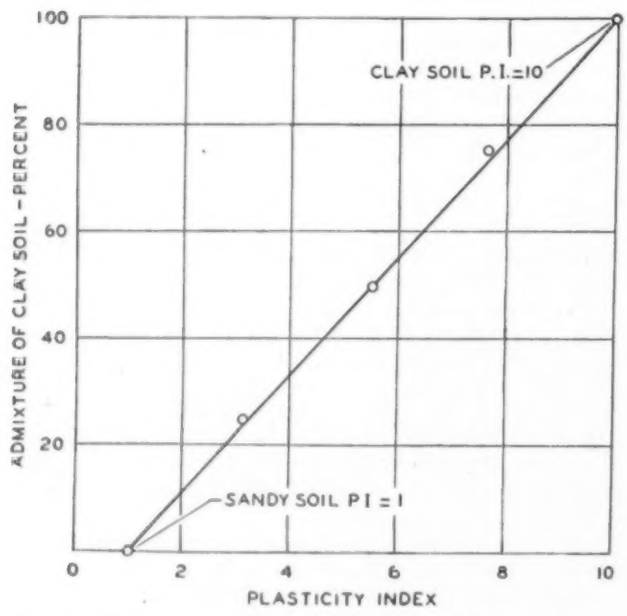

Fig. 15.—Plasticity Index Curve of Particular Soil Fractions for Determining Percentage for Mixture of Soils.

DIVERSION OF MOTOR VEHICLE REVENUE

Sums Diverted from Highway Revenues for Work Relief Actually Provide Less Total Employment and Less Business Stimulus

By T. WARREN ALLEN
Highway Planning Engineer
for Territory of Hawaii Highway Department

DURING recent years there has been a considerable and a constantly increasing diversion of revenues from the automotive registration fees, gasoline taxes, permits, etc., originally levied and intended for highway improvement purposes, to various other uses. This has been done in the face of the fact that the total of all these revenues contributed by highway users is still insufficient to provide the degree of construction and maintenance necessary to the safe, orderly and efficient movement of the traffic which our highways are even now compelled to carry.

Furthermore, these diversions reduce the annual revenue which would otherwise have been derived from the use of highways. Had these funds been used for highway construction and maintenance the result would have been more and better transportation facilities which, through added registration fees and gasoline taxes, would have provided still more highway revenue.

There are other economic evils resulting from this diversion and it is the purpose of this article to consider a third and extremely important one which is generally lost sight of and which is rarely discussed.

The sums which are being diverted from our highway revenues, ostensibly for employment relief and related purposes, actually provide less total employment and less business stimulus than if they had been expended for their original purpose—road improvement. Our economic existence is subject to a multiplicity of influences. The sustaining effect of public expenditures on it varies with the activities to which the expenditures are applied. The value of such expenditures in this respect is measured by the nature and amount of the employment they provide and by the amount of business they cause to be transacted. Therefore activities such as highway improvement which generate a relatively high employment and business volume appear to merit preferential consideration.

Moreover, the stimulus of the expenditures from the diverted funds is mainly to the consumer-goods industries which are already nearly normal, while the stimulus of the expenditures due to highway improvement is mainly to the producer-goods industries which are considerably below normal. In this connection it may be stated that general prosperity is always coincident with great activity in the producer-goods industries.

Just how serious these diversions are may be realized when it is known that during 1934, $141,974,000 in state highway construction and maintenance revenues were diverted to other than highway employment uses and that during 1937 such diversions bid fair to double the amount.

An analysis of the expenditure purposes of this 1934 total shows it to have been used as follows:

General government	$ 61,875,000
Education	32,505,000
Relief	16,221,000
Outlays (non-highway)	19,576,000
Interest	11,797,000
Total	$141,974,000

Through a detailed study of the uses of the diverted funds in the various states this total was broken down according to amounts actually allocated for services rendered and for equipment, materials and supplies furnished. This break-down showed that payments were made for a varied assortment of goods and services which were assigned to basic industries engaged in their production, processing and transportation. Likewise, for an expenditure of an equal amount for highway construction payments would have been made for goods and services and these were similarly allocated to appropriate basic industries.

All of the analyses made for the purposes of this article followed the method used in a bulletin issued by the Bureau of Public Roads in June, 1935 entitled "An Economic and Statistical Analysis of Highway Construction Expenditures," and are summarized in Table I, in which Column 1 notes the industry affected; Columns 2 and 3, the salaries and wages first for the diverted funds, and secondly for highway construction expenditures had the funds been so expended.

Columns 4 and 5 show first man-years of employment resulting from expenditures of diverted highway revenue, and secondly the man-years which would have resulted had the funds been used to construct highways; Columns 6 and 7 in a similar manner show for each industry and for all industries the value of business created first by expenditure of the diverted highway revenues, and secondly the business that would have been created had the funds been used for highway construction. It is interesting to note that in the columns showing wages paid the bulk of labor payments through highway construction are made in the producer, or heavy-goods industries in which unemployment is especially high and persistently continuous, whereas the bulk of labor payments from diverted revenue are made in the consumer-goods industries, in which recovery has been nearly complete.

The columns showing man-years of employment provided from both sources afford a comparison of the ultimate total employment which may be expected to result from these two types of expenditure, as well as the comparative result in particular industries. These columns

TABLE 1

ULTIMATE DISTRIBUTION TO SALARIES AND WAGES, WITH EMPLOYMENT CREATED AND VALUE OF BUSINESS RESULTING FROM EXPENDITURE OF $141,974,000 OF DIVERTED HIGHWAY REVENUE COMPARED TO A SIMILAR DISTRIBUTION OF HIGHWAY CONSTRUCTION EXPENDITURES

Industry	To Salaries and Wages Through— Expenditures of Diverted Highway Revenue	Highway Construction Expenditures	Man-Years of Employment Resulting from— Expenditures of Diverted Highway Revenue	Highway Construction Expenditures	Value of Business Created by— Expenditures of Diverted Highway Revenue	Highway Construction Expenditures
Diverted highway revenue	$ 64,596,300*	.....	51,020*	.....	$141,974,000*	.....
Highway construction	.....	$ 34,628,900*	.....	53,890*	.....	$141,974,000*
Transportation	14,243,000	27,060,500	9,760	18,500	27,517,900	52,281,200
Plant and equipment	16,795,700	22,720,400	13,910	18,940	41,666,900	56,364,400
Aggregate, quarrying	2,781,400	10,227,200	3,390	12,510	6,663,300	24,501,500
Insurance and taxes	6,228,200	9,238,000	3,520	5,220	13,250,800	19,654,700
Cement	1,621,400	6,786,400	1,650	6,940	6,500,400	27,211,000
Iron and steel	3,013,400	5,252,200	2,820	4,900	13,289,800	23,166,600
Petroleum products	1,702,900	3,621,000	1,200	2,560	5,714,100	12,150,100
Coal and coke	3,218,300	3,627,200	3,420	3,850	5,240,200	5,906,000
Power	1,009,300	1,166,000	630	720	4,661,300	5,385,500
Metallic-ore mining	1,754,600	2,222,900	1,500	1,900	4,891,100	6,196,700
Forestry products	3,203,700	2,259,800	4,330	3,040	6,045,500	4,264,500
Advertising and development	1,967,200	1,773,500	1,140	1,040	5,248,400	4,732,400
Explosives	325,900	883,100	270	720	1,586,400	4,296,600
Laboratory	678,100	1,092,100	530	850	1,832,600	2,950,200
Rubber	495,300	639,600	430	550	2,348,800	3,033,600
Brick	573,900	567,800	810	800	1,234,000	1,220,700
Agricultural products	2,933,300	969,800	6,240	2,090	12,107,500	4,003,400
Pipe	215,400	248,400	200	230	1,158,800	1,337,100
Nonferrous-metals refining	188,300	242,500	180	240	2,047,400	2,637,000
Container	46,200	124,600	50	140	217,100	589,100
Retail trade	6,224,400	3,314,400	5,980	3,180	43,588,600	23,209,900
Wholesale trade	2,593,200	1,089,500	1,890	800	33,246,500	13,967,800
Manufacturing	5,564,600	2,218,200	5,510	2,190	17,659,700	7,039,800
Total	$141,974,000	$141,974,000	120,380	145,800	$399,691,100	$448,073,800
Percentage of increase	.....	.....	.....	21	.....	12

*These items are the direct expenditures and results and those which follow below the indirect.

show that 21 percent more employment may be expected as a result of highway construction expenditures than from equal expenditures of diverted highway revenue. As was the case with the wage payments, the bulk of highway construction employment is in the lagging field of producer goods while that of expenditures of diverted revenue is preponderantly in the consumer field, where the greater recovery has already taken place and is therefore less urgently needed.

In the step-by-step distribution of expenditures ultimately accruing to Labor a record was kept of the total value of the business transacted in each industry. Columns 6 and 7 show this value for each industry in each type of expenditure. It will be noted that 12 percent more business is transacted as a result of highway construction expenditure than results from the expenditure of an equal amount of diverted highway funds.

In order to emphasize the type of industry which is bolstered or stimulated by each of these two variant types of public expenditures, a further classification of the value of business transacted was made, into the groups of durable or producer goods and nondurable or consumer goods. In the case of the expenditure of diverted highway revenue, the total value of business, $399,691,100, is found to be $168,412,800 in the durable goods group and $231,278,300 in the nondurable goods group, whereas the total value of business resulting from the highway construction expenditure, $448,073,800, is found to be $375,465,800 in the durable group and $72,608,000 in the nondurable group. Otherwise expressed, to the field of heavy durable producer goods, which was only 71 percent recovered from depression, highway construction brings the stimulating effect of 84 percent of total business transacted. By way of contrast, of the total business resulting from the expenditure of the diverted highway funds, only 42 percent was in the heavy industries field while 58 percent was in the light- or consumer-goods industries. The net effect of the diversion of highway revenues is therefore to primarily stimulate the field of nondurable consumer goods, already 94 percent recovered from depression, at the expense of the durable goods group.

These data provide the further implication that the benefits of business initially transacted in the field of the heavy-goods industries are passed directly on to the consumer-goods field, whereas that business originally transacted in the field of consumer goods is beneficial to the producer field only through processes of reinvestment, measurably slowed in time of depression.

All the assembled data clearly indicate that highway construction definitely bolsters that field of economic activity which is vital to prosperity and which is in the greater need of assistance and that any diversions from our highway funds seriously retard recovery in that field.

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GRADE CROSSING ACCIDENTS—Over one-third, 37.8 per cent to be exact, of the highway-railroad grade crossing accidents for the year 1936 were caused by drivers running into the sides of trains.

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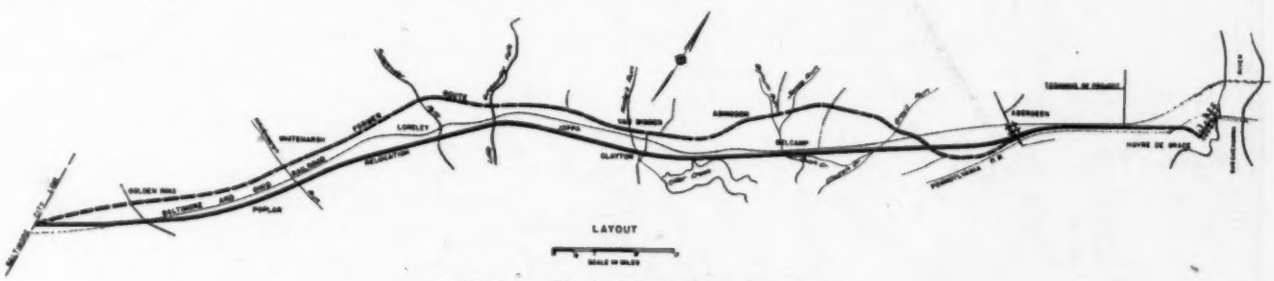
GRADE CROSSING DEATHS RISE IN 1937—In the first nine months of 1937 there were 3,094 accidents at highway-railroad grade crossings, an increase of 291 compared with the same period of 1936. Fatalities resulting from these accidents in the nine-month period in 1937 totaled 1,305, an increase of 165 compared with the same period of the previous year, while the number of persons injured was an increase of 246, there having been 3,266 persons injured in the 9-month period of 1937.

Maryland Opens First Dual Highway

Easy Grades, Easy Curves, Stabilized Base, Center Drainage Are Features of New Route

CLIMAXING three years of planning and construction, Maryland celebrated the opening of a new dual highway leading for 27½ miles out of Baltimore toward Philadelphia. It was named the Governor Nice Highway, and is planned to eventually tie up with the DuPont Highway in Delaware. Costing upwards of $190,000 per mile, the new 9 in. 7 in. 9 in. plain concrete highway is on entirely new location.

On Friday, Jan. 14, 1938, Governor Nice clipped the ribbon opening the road from Baltimore to Havre de Grace. After the ceremony on the road, the official group gathered at the Maryland Club to present the future plan of this road to Delaware and Pennsylvania officials. It was hoped that a tie up plan could be arranged with the cooperation of those two states, such that Wilmington and Philadelphia could be by-passed and make the new road part of a fast North-South route between Washington, D. C., or Richmond, Virginia, and New York City.



Old Route U. S. 40 and New Location

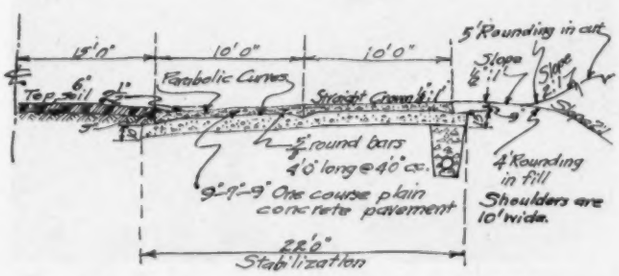
The accompanying plan shows the new road and proposed connections as well as other by-pass studies made by the Maryland Highway Planning Commission. Maximum grade on the new road is 6 per cent and maximum curvature, 2 deg. 30 min. Wherever unsatisfactory base material was in the grade, it was removed to a depth of 10 inches to 3 feet, as required, and back filled with stabilized gravel. French drains conduct ground water, which was reduced from 19 per cent content to 4 per cent by stabilization, to side tile lines. There are over 65,000 lin. ft. of 4-inch tile drain installed.

An accompanying diagram shows a half section of the road. It will be noted that the slabs are only 10 ft. lanes. The outer lane is flat and raised on the outside so as to drain toward the inside. At all times, regardless of curvature, drainage was toward the inside. The inside lane is crowned by 2½ in. and contains a lip curb on the inside edge. At proper drainage points, the surface water is picked up by inlets and carried underground, where it is dumped at points that will not damage embankments. This cross-sectional design is peculiar in that it throws a reversed super-elevation on some of the curves. The Maryland engineers felt that this would not be detrimental to fast driving particularly since no curvature is greater than 2 deg. 30 min. All excavated frost heave material or unsuitable base material was dumped along the edges of embankments to make the embankment wider. These fills appear like benches or berms of the highway embankments. They should be beneficial in many of those places where muck was encountered. In some places the muck ran many feet in depth. It was dynamited and the fill allowed to settle to harder foundation. Widening of the fills with base-excavated material will place a superimposed load on the ground adjacent to the fills and help prevent fill settlement.

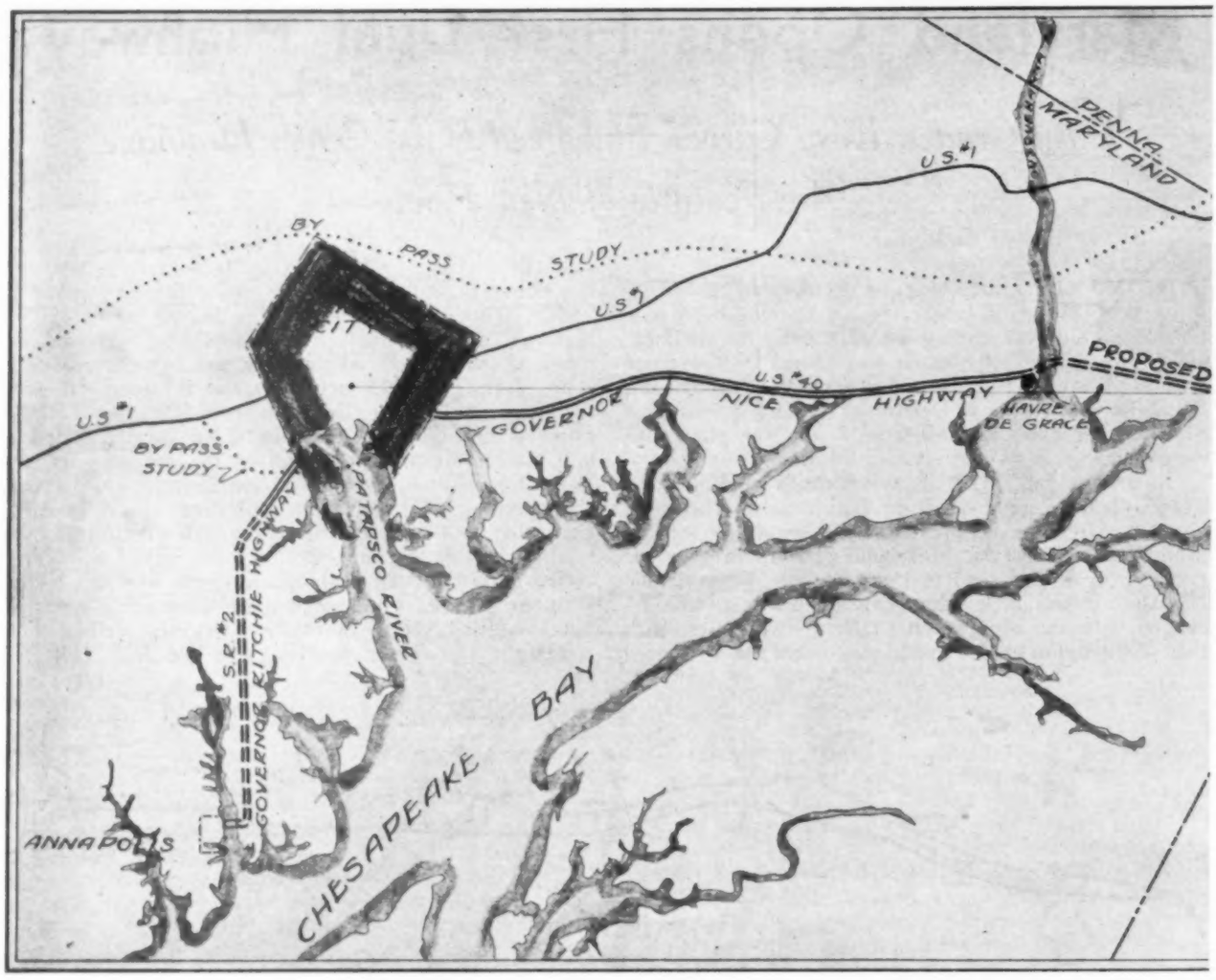
Inspection disclosed many incipient erosion conditions that will need extensive roadside treatment. In readily erodible soil cuts, the ditch was paved with concrete. Cut back-slopes, however, were washing badly in many places. The shoulder and back-slope work is not completed yet. Construction requires seeding and sodding. The center parkway, 30 feet wide, will be covered with 6 inches of top soil and sodded. The 10-foot shoulders will be rounded, as shown by the half cross-section. It is planned to gravel and waterproof the shoulders in a year or two.

General Plan Information

Traffic studies along the old route of the Baltimore-Philadelphia road, U. S. 40, indicate that a majority of the traffic either originates on or is destined to some point along the road. Half of the through traffic stops in the cities. It is the desire of Governor Nice of Maryland and Dr. H. E. Tabler, Chairman of the State Roads Commission, that this highway become part of a fast North-South route between Washington or Richmond and New York. The governor is anxious to serve the motoring public. While this road was initiated prior to



Typical Half Cross Section of Governor Nice Highway



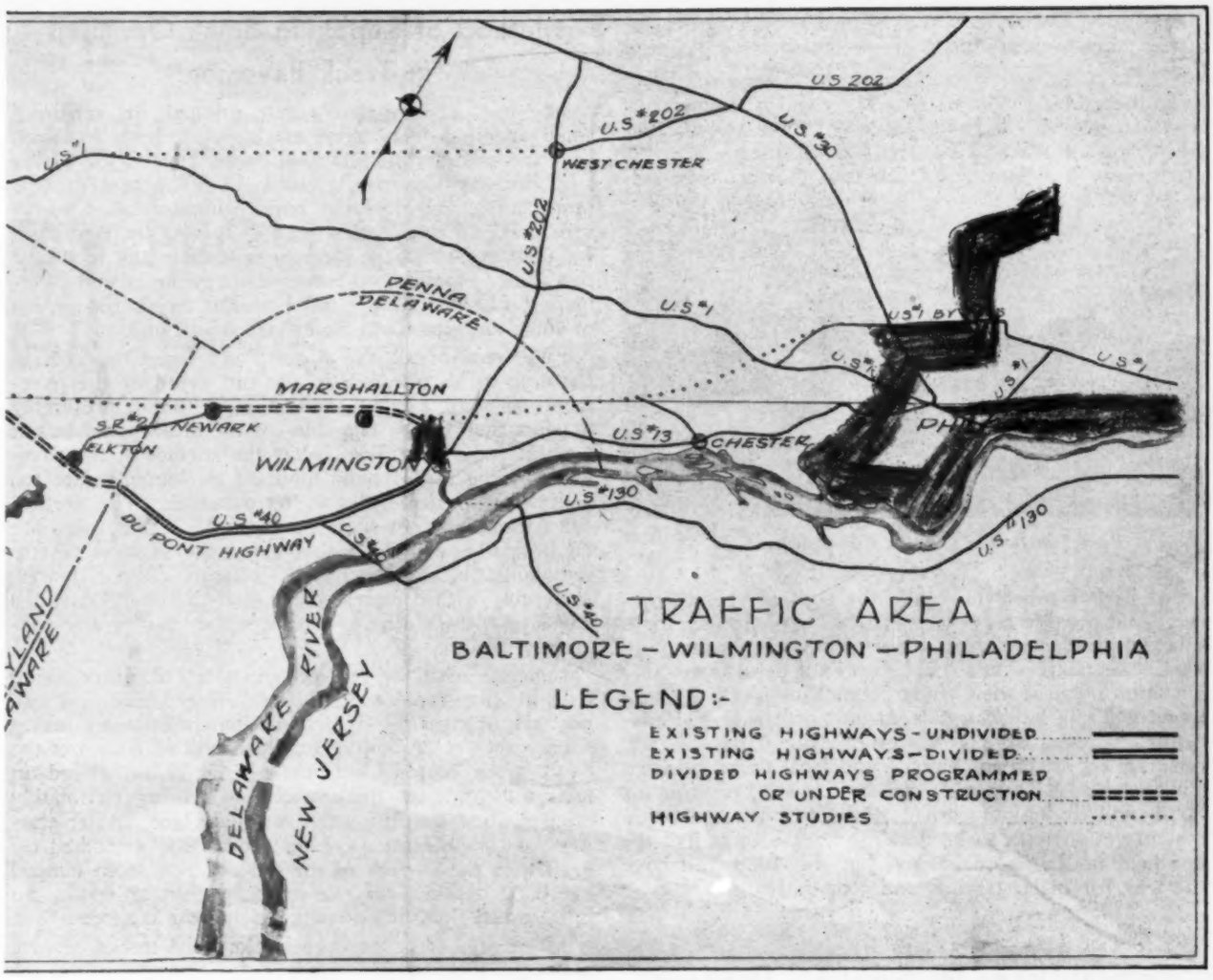
Highway Plan Study

his incumbency, he hopes to tie it into a transportation plan.

Such a plan will require the cooperation of Delaware and Pennsylvania if Philadelphia is to be by-passed. At the present time there is no approved plan for by-passing

Constructing Fill. Route follows entirely new alignment.

Shooting Muck Soils to Get Fill Settlement



Highway Plan Study

Philadelphia with a road that will tie into the Governor Nice Highway. If this road is to continue southward as part of a through, fast road, a tube will have to be projected under the Baltimore harbor as indicated by the dotted line. Such a project would be extremely expensive, but Mr. B. H. Griswold of Baltimore, Chairman of the Citizen's Committee, says that his rough preliminary calculations indicate that the project could be made a profitable venture and help to pay for construction of a like tube under the Potomac River south of Washington and thus by-pass through traffic from there to Richmond. The new road will require a new bridge over the Susquehanna River at Havre de Grace. This project will cost in the vicinity of $3,000,000. As yet there are no plans for starting construction on it.

With a by-pass off Route U. S. No. 1 to the south side of Baltimore, going through a tube under the harbor, thence on to the Governor Nice Highway and over the Susquehanna River bridge, fast traffic could go on to New York on the New Jersey side if a tube were also constructed under the Delaware River in the vicinity of

Grading in Progress on the New Line.
Nello L. Teer, Durham, N. C., Contractor.

Grading on Another Section of the New Line. H. T. Campbell Sons, Baltimore, Md., Contractors.

New Castle, Delaware. At present a poor ferry service at this point prevents this route becoming a fast through highway.

To the writer it appears that Maryland is stymied unless a connection can be developed in Pennsylvania that will by-pass Philadelphia. Mr. Griswold states that his preliminary studies indicate that tolls that could be collected at the Susquehanna River bridge and at the proposed harbor tube would pay for both of these structures and provide a profit with which to help pay for a tube under the Potomac River south of Washington, D. C. As matters now stand, from a general fast transportation point of view traffic from New York to Richmond will still be delayed from the north side of Philadelphia on south. The Governor Nice Highway will certainly serve for commercial and local traffic between Philadelphia, Wilmington, and Baltimore. Whether or not it will fit into the broad East Coast transportation system yet remains to be developed. Meetings like the one held in Baltimore Friday, Jan. 14, 1938, will pave the way for understanding and cooperation.

Bath Tub Bridge at Little Gun Powder Falls.

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Vertical Drains for Substrata Drainage

An interesting method developed in California for dehydrating marsh lands in connection with highway construction was described by F. J. Grumm, Engineer of Surveys and Plans, California Department of Public Works, in a paper presented last month at the 35th annual convention of the American Road Builders Association. This method consists of sinking a large diameter well casing to the bottom of the unstable material and as the casing is removed, filling the hole with a porous and granular material. The spacing of the vertical drains depends on the source, extent and condition of saturation. It has been found that the rate of consolidation of the unstable material under the load of the superimposed roadway fill is greatly accelerated, and, if sufficient time is allowed between construction of the roadway and the final paving, a fairly stable foundation is secured. Precaution must be taken during construction to prevent lateral movement of the underlying material and the tops of the vertical drains must be connected to a convenient outlet by means of porous subdrains.

Theory substantiated by experience on construction work, indicates that time required for consolidation is proportional to the square of the depth of the layer. Due to the increased rate of consolidation by the use of the vertical drains as indicated by results to the present time, it is believed possible that mud deposits up to 50 ft. or more in depth may be consolidated by this method and stabilized in about one year.

Method of Repairing Small Openings in Track Pavement

The use of a damp concrete mixture for repairing small openings in concrete track pavement has proven very successful and economical on the lines of the Cleveland Railway Co. of Cleveland, O. The procedure is quite simple and does not require highly skilled workmen. The method is described as follows by Wm. Aid, Maintenance Engineer for this railway in the report of this Joint Committee on Street Railway Track and Pavement Construction, presented at the recent convention of the American Road Builders Association.

First remove all the broken and loose concrete in the area to be repaired, to the full depth of the pavement, or until a solid foundation is found, preferably not less than 6 in. The sides of the area should be cut vertical for a least 3 in. below the surface of the pavement by the use of hand tools, as air hammers are too heavy for vertical sides to be obtained. The vertical sides should be cut back far enough so that there are no broken or sloping places along the surface. After removing the old concrete, thoroughly clean the area, preferably with compressed air, and thoroughly wet the surfaces without leaving excess water, before any concrete is placed.

Concrete used for replacement is a 1:2:3 mix, using a ½-in. size stone, with a water content of 3 to 4 gal. per sack of cement. This small amount of water makes a very dry "mealy" mixture which will scarcely wet the hand when handled. Concrete should be placed in layers about 2 in. thick, each layer being thoroughly tamped, so as to bring water to the surface. After placing the concrete the pavement surface is smoothed off even with the surface of the old concrete, then tamped every 20 minutes for one hour. Vehicular traffic can be resumed three hours after placing the concrete.

If the area to be repaired is along the rail of a track making it necessary to remove the concrete below the base of the rail, plastic concrete should be vibrated under and around the base of rail, and allowed to set for at least 24 hours, before the surface concrete is placed.

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New Road Code Violators Arrested

The highway patrol of the Minnesota Highway department brought 378 traffic law violators into court during the month of December, the report of John P. Arnoldy, patrol chief, revealed.

Fines totaling $4,924 were imposed, bringing the year's total to $98,743.76. Improper equipment led to the arrest of 120 drivers, while 63 were apprehended for going through "stop" signs, and 41 were arrested for driving while drunk.

The patrol gave aid to 3,492 motorists during the month, according to the report. Of this number minor adjustments and repairs accounted for 1,202 of the stops. Fourteen injured persons were given first aid. During the month the guardians of the highway tested 5,199 pairs of headlights.

Because of illegal equipment, "must repair" tags were handed out to 1,482 highway users and 5,864 violators of the traffic code were warned to mend their ways. Improper lights brought 1,572 of the warnings.

Being the last month of the year, license correction receipts took a dive to a low of $2,322.90. Funds thus recovered for the entire year enriched the state by $221,169.28, the report stated.

THE MANAGEMENT OF HIGHWAY GRADING

An Early Effort at Using Power in Moving Material: Engine and Cars Used for Hauling Crushed Stone from Quarry to Road in Oregon, Photo Taken in March, 1914

The Fifth of a Series of Articles Dealing With Its Economic Aspects

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau Public Roads, Washington, D. C.

IN MANAGING grading work for high production the matter of the type of hauling equipment it will be desirable to have is pretty certain to arise. As to the questions this matter presents, there usually is no certain answer, for the conditions under which work must be done vary a good deal from job to job, and no type of hauling equipment meets all of these varying conditions equally well. This being the case, the selection of the hauling equipment should depend on the conditions most likely to obtain over the period during which the equipment is likely to remain in serviceable condition. Some consideration of these conditions should, therefore, be useful as suggesting the points to be considered in selecting such equipment.

Hauling Equipment Exchange Time

The first point to be considered in regard to hauling equipment is its ease of manipulation. It may be suggested that dependability is a more important matter than ease of manipulation. This is readily admitted but the mechanical perfection of construction equipment has now been brought to such a point that, in practice, dependability can ordinarily be assumed. This same cannot, however, be said as to facility of maneuver, though this also has been greatly improved during the past ten years. Every load that is handled involves turning around at the shovel (or the elevating grader), perhaps backing under the shovel if space is limited and turning around on the dump. These operations are repeated with every load. In the very nature of the case the time spent on them is unproductive—from the production standpoint wasted time—so as they are repeated day after day and week after week the amount of hauling time that is lost when they are not easily and quickly accomplished can be quite important.

It must also be noted that if a shovel is picking up three dipperfuls a minute only 20 seconds is available for changing wagons at the shovel. Whatever time is used in excess of this 20-second period reduces the production of the shovel. Slow moving hauling units—or units poorly handled—can reduce the production of the shovel and also of an elevating grader a good deal by merely increasing the wagon exchange time a few seconds. Take as a simple illustration a job on which three dipperfuls are put onto each truck. One truck should be loaded every minute—60 an hour. If, instead of a 20-second wagon exchange period, a 30-second exchange period is used, it takes 70 seconds to load a truck. The possible output at the shovel is, then, reduced to 51 trucks an hour—a loss of 15 per cent in job output! As no element in cost is likely to be correspondingly reduced, unit production cost is increased more than 17 per cent by inattention to this often seemingly unimportant detail. As a matter of fact, there is no single point on a shovel job or on an elevating job that needs more careful attention, or repays this attention more liberally, than the wagon exchange time. It is the point at which the hauling operation and the digging operation intermesh with the result that any drag here shows up as definitely reduced production.

Example Showing Importance of Prompt Truck Exchange

Nor is the importance of a prompt wagon exchange at the shovel and at the elevating grader overemphasized by the above comments. Rather astonishing illustrations of the results of the failure to appreciate the

Grading on the Blue Ridge Parkway in North Carolina

importance of wagon exchange time could be given in considerable number. One that occurs to the writer at the moment involved a job on which a contractor was using long wheel base trucks. The cut, as he had opened it up, was so narrow that these trucks could not turn around in it. He had permitted the floor of this cut to get into such bad condition that the trucks could use it only as a one-way road. When the writer saw this job an exchange of trucks required the loaded truck to pull out a distance of about 500 feet in low gear, after which the empty truck backed in to the shovel. Under these circumstances the exchange took a minute or more. As only four dipperfuls were put onto a truck, loading usually required only a little more than a minute. Inevitably production was low because nearly half of the time of the shovel was being wasted by this long wagon exchange period.

Dumping Facility Important

Facility in dumping the load is an important consideration in the selection of hauling equipment. End dumped fills are now seldom permitted so the old practice of backing the truck to the edge of the fill and then dumping the load over the edge is not widely practiced. Special conditions necessarily require special treatment but, as a rule, the present practice is to dump along the fill which is brought up in lifts. This being the case, it is of advantage to use hauling units that can be dumped without stopping. Such units lose no time on the dump except the time required to turn around. It takes very little time to do this unless the unit must back once or twice to make the turn as was common when long wheel base units were used in narrow fills. Fills are being constantly widened and hauling equipment is being designed for shorter turns so that is less need for caution here than there was formerly. However, there still are so many highway grading jobs offered on which the fills and cuts are narrow that it pays to consider the turning room that usually will be available whenever new hauling units are being considered.

Hauling Units

As between trucks and tractors as types of hauling units, both have advantages and both disadvantages. Tractors have a very definite advantage in rough country and, in fact, under all conditions which involve rough going. Necessarily they are not as effective in mud or when the going is difficult as they are when the going is good. Still, even when conditions are rather surprisingly adverse, they keep moving and accomplish a great deal.

On the other hand, trucks require good road conditions if they are to work efficiently, but when the road conditions are good they are outstandingly efficient. They are particularly efficient on long hauls which can be made over roads that can be kept in such good condition that their capacity for speed can be utilized.

Selection of Hauling Unit Depends on Working Conditions

Here, then, the choice to be made is between the heavy load the tractor will move at a relatively low speed and the smaller load a truck will move at a considerably higher speed. Final decision depends primarily on the conditions under which the hauling units will have to work. The fact that there is almost nothing that can stop a tractor tends powerfully to encourage their use on grading work in rough country and wherever adverse ground conditions are to be expected. That they also work well when ground conditions are good properly encourages their wide use in the grading field. The fact remains, however, that when hauling conditions are good—and particularly when the haul distance is long—trucks may have a considerable advantage both from the standpoint of the investment that is involved and from the standpoint of operating cost, which is, of

Shovel Grading for Widening and Loading Into Trucks on U. S. Route 1 in Virginia

course, of still greater importance. Thus, as an illustration, assume a single tractor-drawn wagon worth, say, $5,000 and a modern light truck worth about one-fifth of this amount. In practice, loading under a 1¼-yd. shovel, the wagon will take some seven or eight dipperfuls. The truck usually will take two. As the tractor-drawn wagon will be diesel engine powered, operating cost (except repairs and depreciation) will be little if any greater than the cost of operating the truck. Turning time on the dump and at the shovel will be about the same for both units but as it takes only ⅔ minutes to load the truck while it will take 2⅔ minutes to load the tractor-drawn wagon (three dipper loads a minute) the dead time for the truck will be say 2½ minutes as compared with about 5 minutes per trip for the wagon tractor unit. If going is good the tractor wagon outfit will require about 10 minutes to haul a load of 1,250 ft. and return or 15 minutes for a round trip. The truck, however, will require less than 3 minutes for hauling and return if ground conditions are such that it can average 10 miles per hour or a round trip time of slightly over 5 minutes, that is three loads to the tractor's one. At about a 2,500 ft. haul the truck can haul four loads to the tractor's one, or as much per hour as the tractor. Above that haul distance it can haul more per hour than the tractor outfit as long as

road conditions will enable it to make use of its capacity for speed!

It matters not at all whether the assumptions made above are accepted or are altered in some particulars. The fact remains that they are accurately illustrative of the manner in which these two types of hauling units compete. On short hauls, in rough country and over bad ground the tractor-drawn wagon type of equipment is at a definite advantage because of low operating cost and relatively low labor cost. On long hauls it maintains this advantage except when the hauling can be done over ground that can be kept in such good condition that the trucks can utilize their capacity for relatively high speed. For this reason the use of tractors in the grading field increases rather steadily except where long hauls are the rule and ground conditions such that they can be depended on to permit trucks to work at high speed.

The above discussion is based on the assumption that the contractor is a grading contractor or at least is operating specific outfits solely as grading outfits. The contractor who does miscellaneous highway work naturally will not view his equipment problem from quite the same point of view that the grading contractor will accept as normal. From the standpoint of the man who is doing miscellaneous work, versatility is more important than the last bit of economy specialization in a narrow field will permit. He is, therefore, more likely to prefer trucks to tractors because they are more versatile—fit into the scheme of things on a wider variety of jobs. There certainly can be no objection to this point of view as it is based on the experience of a great many contractors who find operation on this basis profitable.

Hauling and Elevating Grader Operations

In the elevating grader field large hauling units have been popular because they reduce the number of wagon exchanges it is necessary to make. As a rule the grader is stopped during the exchange period. The stop need not be long, a matter of only a few seconds, if the replacement unit is driving close behind the unit that is being loaded—but as the grader digs at a high rate per hour the use of small hauling units increases the number of these waiting periods very materially and therefore the fraction of the day that is lost by the elevating grader during wagon exchange periods. It naturally follows that higher production usually is had where large hauling units are used merely because the grader actually is at work during a somewhat increased fraction of the day.

For successful elevating grader operation it is quite as important as on a shovel job to keep the wagon exchange period as low as possible. On the shovel this means keeping the replacement unit so positioned that the loaded unit can pull out and the empty unit can pull in within the 20 seconds normally required for picking up the next dipperful. On elevating grader work the loading unit is in motion at about the same speed at which the grader is moving. If it is moving toward the dump the loaded unit merely keeps on when the grader stops to let the replacement unit move in. If the grader is moving away from the dump the loaded unit must turn out and around when the grader stops, and in doing so keep clear of the replacement unit. In either case the replacement time depends on how far back the replacement unit is trailing behind the loading unit. For high efficiency it should be kept as close as possible to the loading unit. As tractors usually work at a speed that is not far from 4 ft. per second, it should be clear that an exchange time of under three or four seconds is out of the question. On the other hand, if the empty unit is allowed to trail 40 or 50 ft. behind the loading unit, inevitably this exchange time is raised to from 12 to 15 seconds. As even a large hauling unit should be loaded in good ground in not much over a minute, the percentage of the time of the grader, and with it the percentage of possible production, that is lost if there is any lack of attention to this detail may be considerable. Where small hauling units are used the loss of production which results from inattention to this detail is, of course, correspondingly increased.

The introduction of diesel engines now almost universally used on tractors has been a large factor in increasing their popularity. It has reduced operating cost and at the same time increased the dependable life of these units. Another relatively new thing in the construction field is the large heavy duty pneumatic tire which is now widely used on large wagons and on various other types of equipment including some types of tractors. Various advantages are claimed but of these

Elevating Grader at Work Between Chatfield and Fountain, Minn.

none is at the moment more certain than that these tires do tend to keep the subgrade in better condition and by so doing to improve working conditions. Wheeled vehicles do not work too well in the mud but these large heavy duty tires will carry heavy loads over ground that would rut under smaller tires, and over ground on which there is a good deal of surface mud.

Weather Conditions Important Consideration

In grading work wet weather, with the mud and the slush that accompany it, offers one of the most important problems with which contractors operating in this field must deal. In the days of horse-drawn grading equipment it was a universally accepted rule that the outfit worked whenever more dirt could be moved than was required to pay the men. The basis of this rule was simple enough. The animals had to be fed whether they worked or not. Often the men had to be fed too. Equipment was worth little and when idle rusted out about as fast as it wore out when at work. In any event, however, it was worth so little that it played no considerable part in the cost structure. It naturally followed that, no matter how bad the weather might be, if more than enough dirt was moved to pay wages, something was earned that day toward paying for feeding the animals. On a typical job of this sort, wages were about $50 a day, plus board for the men, which was furnished whether the men worked or not and which was about $15 a day. Some 45 animals were kept at a cost of about $40 a day. Dirt moved was worth 25 ct. a cubic yard. It then took 200 cu. yd. of dirt to pay the men and about 220 cu. yd. more to pay for their board and for feeding the horses. It was a very bad day indeed when the outfit could not get out better than 200 cu. yd. In fact it was unusual to have weather so bad that, if work could be done at all, the 420 yd. it was necessary to move to handle out-of-pocket costs could not be taken out. Needless to say an outfit of this sort worked when the weather was pretty bad and the horses couldn't drag much more than half of a load to the dump. It was a matter of very simple arithmetic to show that this was the profitable way to operate.

Effect of Mechanization

But mechanization has very materially altered this situation. In the first place, idle equipment does not now generate burdensome out-of-pocket expense. The horse and the mule had to be fed whether they worked or not. The gasoline motor and the diesel engine consume fuel and oil only when they are at work.

In the days of horse-drawn equipment, the equipment itself was so crudely built that working it under adverse conditions did not materially alter the cost structure. Modern equipment, though rugged and now pretty well protected from the effect of mud and dust is, nevertheless, not so well protected but that its useful life can be definitely shortened by using it under adverse road conditions. Then, too, when road conditions are bad—particularly when the roadways are soft from too much rain—hauling equipment frequently mires down and is overstrained in extricating itself. Accidents are not uncommon. In short, working in the mud decreases the useful life of modern equipment, tends to increase repair costs and is often responsible for expensive accidents. The effect of these things cannot be very exactly evaluated but it will be universally accepted as a fact that working in wet weather does add so materially to the rate of depreciation and the expense of repairs that the effect is clearly apparent in the unit cost at which work is done whenever much of it is performed under such conditions.

Tractor Trucks Lined Up Behind Elevating Grader on Federal Aid Project in Jeff Davis County, Mississippi

Wet weather also reduces the speed at which hauling can be done. This effect is not as noticeable where tractors are used as where trucks are used, but without regard to the type of hauling equipment bad ground always slows up operations on a shovel or an elevating grader job. If the going is really bad it is also necessary rather sharply to reduce the amount carried. Inevitably, then, the rate of production is reduced.

Finally, and this fact deserves more consideration than it usually receives, working in wet weather is likely to rut the ground over which hauling must be done so badly that the speed at which hauling units, trucks in particular, operate, will be reduced for several days. The result is low production not only during the wet weather but for some days after it is over.

To put this matter in a little different way, the out-of-pocket costs on a grading job on which animal power was used were principally for wages and for feeding the men and the livestock. This feeding cost remained to be met whether work was done or not so it was desirable to work in bad weather as long as any of the feeding cost could be covered out of the work done. On the modern job, out-of-pocket cost ceases when the work stops except for a relatively small number of men who are carried on a straight time basis—usually the superintendent, the timekeepers and perhaps a few others. On the other hand, work being under way, the daily cost of running the outfit—wages, operating costs, etc.—are pretty nearly constant whether production is high or low, except as working in bad weather somewhat increases the wear and tear on equipment, repairs, etc.

Eight Yard Trucks and a 6-yd. Wagon as Used on a Colorado Project

Excavating Material for Surfacing from Bar in South Fork of Merced on Wawona Road, Yosemite Park, California

This will be obvious on a moments thought. Wages, of course, are constant. Fuel and oil consumption are not reduced—usually are increased—when the going is bad. Repairs are increased if altered at all. It follows that the unit cost of production increases somewhat faster than production decreases, from which it is logical to conclude that it seldom is sound policy to work a modern shovel or elevating grader outfit under any conditions that will cause low production—much better practice to lay up the outfit for a day or two until ground conditions are such that at least nearly full production can be maintained.

In the above comments no reference has been made to other than standard types of hauling equipment, trucks and tractor-drawn wagons. In addition to these there are several types of specialized hauling equipment which are available tc a contractor. In the past some use has been made of industrial railroad as the hauling equipment on grading work. The fact that a good deal of time was usually lost in exchanging trains has made it difficult to adapt this type of transportation to modern production standards. Insistence on layer dumping and on rolling each layer to a reasonable degree of compaction before the next layer is put down, has further interfered with the effective use of this type of hauling equipment.

Track type wagons, some of which carry their own power and so may perhaps be rated as trucks, have proved quite successful on projects on which it was necessary to work over a good deal of soft ground. They also have proved quite successful on jobs where working conditions have been generally difficult. However, as highly specialized equipment, although quite efficient under the conditions it is designed to meet seldom can show great versatility, contractors whose work must be done under a wide variety of conditions seem to prefer to depend on the more standard types of equipment. While this viewpoint is natural enough, some of this highly specialized equipment deserves careful consideration.

An interesting non-standard type of hauling equipment is available in those units designed to run with about equal facility whether going ahead or backing. The obvious objective is to avoid the loss of time that is involved in turning around. A truck that is working on a 450-ft. haul at a speed of 5 miles an hour takes say one minute to maneuver at the shovel, one minute to maneuver on the dump, one minute to take on the load and two minutes to haul it and return for the next load. It is, then, using two-fifths of its working time in maneuvering on the dump and at the shovel.

Admittedly, the maneuvering time as stated above is rather long for a modern truck working on a fill of the width customarily used today. Still, even under good working conditions it will usually be found, when these operations are timed in the field, that a goodly fraction of the working time of all standard hauling units goes into them. This being the case, these units that run with equal facility both forward and backward do have some potential advantage at this point for it is unnecessary for them to turn around. Once operators are accustomed to handling them they can be made to cut hauling time on short haul jobs and a good many of them have been successfuly used. However, while the advantage they have on short hauls has warranted the consideration they have received, it is only reasonable to observe that on long hauls this advantage is of much less importance. As the tendency during the past ten years has been to increase haul distances, and as other types of hauling units have been designed for shorter and quicker turns, the advantages these units once had at this point has been considerably reduced.

▼

171,932 Miles on Local Roads Transferred to States

Since 1931 a total of 171,932 miles of local roads have ben transferred to the states. The following tabulation from the report of the Department of Highway Finance, presented December 2 at the annual meeting of the Highway Research Board, shows these road consolidations by years:

Year.	State.	Local Road Mileage Transferred to State
1931	North Carolina	46,826
	Pennsylvania	20,167
	Louisiana	6,658
	Total	73,651
1932	Virginia	37,028
	Total	37,028
1933	West Virginia	29,098
	Oregon	2,046
	California	6,600
	Total	37,744
1934	Minnesota	4,356
	Missouri	937
	Georgia	367
	Indiana	871
	Kentucky	659
	Total	7,190
1935	Delaware	2,602
	Nebraska	1,391
	Missouri	834
	Nevada	796
	Total	5,623
1936	Arizona	428
	Georgia	648
	Kentucky	340
	New Mexico	2,021
	Ohio	2,391
	Oklahoma	606
	South Carolina	419
	Texas	579
	Missouri	914
	Pennsylvania	2,350
	Total	10,696

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ How times change. Charlie Upham was building Delaware's Du-Pont dual highway when he issued the following order (note the date):

July 1, 1920

Dear Sir:

Sometime ago we requested that State speed law should not be exceeded by the drivers of State automobiles.

It is difficult to check up the speed at which a man drives other than by taking his own word. I have asked each man not to exceed a speed of twenty-five (25) miles per hour. I am now obliged to make this an order, and will ask for the resignation of any man exceeding this speed.

Yours very truly,
State Highway Department
CHAS. M. UPHAM,
Chief Engineer

• •

¶ A steel through truss when painted white looks nice but let it get rusty looking like those over the Monacacy River on U. S. 240 and State Route 15 in Maryland and they are repulsive. Paint 'em up, Nate.

• •

¶ On a late trip last fall in central New York State I encountered this bituminous resurfacing job. The contractor, on a road west of Baldwin, was laying a fluxed tar mixture with an Adnun black top paver on an old concrete paving. It was raining. The paving was wet and the resurfacing was about 1½ in. thick. Each time the roller passed by I noticed that the coated aggregate pushed about an inch or more ahead of the roll. This spot will bear watching to see if it peels off.

¶ All praise and commendation to the State Highway Department of Pennsylvania on the Stoyestown cut-off. One of the most dangerous and treacherous mountain roads on U. S. 30 in Pennsylvania is being eliminated by a several mile long relocation with easy grades and curves. The job is not finished yet. We hope it will be the next time we head for Baltimore, Washington or other eastern points.

• •

¶ Ever had a Maryland terrapin lunch or dinner? It's great. Of course the high prices (about $3.50 or more) per plate usually rules it out of the average menu. But—before the Civil War plantation owners in Maryland were forbidden to feed terrapin more than 3 times a week to slaves.

• •

¶ One good feature about the Governor Nice Highway in Maryland (just opened) is the extra width of fill matarial on embankments, particularly in the swampy areas. A different feature is the reversed super-elevation on certain curves—the slab slopes the wrong way.

• •

¶ It's too bad that Maryland's $190,000 per mile new dual lane highway has such narrow lanes. They'll pay for it in extra maintenance cost.

NATIONAL PAVING BRICK ASSOCIATION
NATIONAL PRESS BUILDING
Washington, D. C.

A. Puddle Jumper,
% Roads and Streets,
Chicago Daily News Bldg.,
Chicago, Illinois.

Dear:

Your request for definitions for the word "Maintenance" which appeared in a recent Puddle Jumper column reminded me of what I had written on this subject in 1927 which is over ten (10) years ago. It does not seem that long since I expressed myself and my comments of that time quoted below are still pertinent.

"The meaning of the term highway maintenance is not fixed and the exact operations included may vary with different highway organizations. Maintenance in the dictionary sense, means to preserve something in its original condition. In many states, all forms of routine repairs, resurfacing, reconstruction, including widening and minor grade and alignment changes, are classified as maintenance—frequently in order that they may be eligible to receive a certain class of appropriated funds. In private industry, such as a railroad company, it is important that any expenditure for reconstruction that is greater than that required to 'renew in kind' be classified as an addition and betterment and a strict accounting made of it. The company is thereby enabled to capitalize this account and increase its credit and borrowing powers. While most highway departments make attempts to distinguish between betterments and routine maintenance, there is not the incentive in the way of financial advantage for a rigid classification."

Yours very truly,
GEORGE.
GEORGE F. SCHLESINGER,
Director.

CONCRETE TRANSPORT MIXER CO.
650 ROSEDALE AVENUE
St. Louis, Mo.

A. Puddle Jumper,
% Roads & Streets,
400 West Madison Street,
Chicago, Illinois.

Dear Sir:

This is to acknowledge my appreciation of your contribution towards the improvement of motoring conditions throughout the country. There is no doubt that many of the things to which you call the attention of various highway authorities will be corrected, but only after constant pressure and frequent repetition.

Your method of commending various officials for their progress should have far-reaching results with those who are rather lax to accept suggestions for improvement in conditions in their states.

I was very much interested in your description of your entry into California. My actions were practically identical with yours, and my resentment was caused not so much with the examination as with the methods used. My impression was that the same result could be obtained, and still leave a kindly feeling toward the officials and the state of California by a little more courteous treatment on the part of the inspector.

Keep up the good work, and I am sure you will have a very grateful public behind you.

Yours very truly,
Concrete Transport Mixer Co., Inc.
T. H. FLEMING,
President

• •

¶ Forest roads need improvement the same as other roads. This big outfit took up most of the existing roadway at the 6,000 foot level in the Gen. Grant National Forest. Note the narrow treads on this big tractor. They were ordered especially by the engineer. The operator of the tractor complained that they dug in too quickly, thus greatly decreasing his pulling ability although he had power to spare.

Dear State Highway Dept.
Lansing, Michigan

The Curve Just North of Wayland, Michigan

The Engineer from your Department who laid out this curve was either

(a) Drunk or
(b) He was in a trance and thought he was laying out an Indianopolis Speedway.

If something isn't done about this curve, more than one person will be killed or seriously injured this winter. Then blood will be on your hands.

This curve is banked for a speed of above seventy miles an hour and on a slippery day, without tons of sand, this curve is absolutely impossible. If you don't believe it have some one go and try it some day. The curve, 2 curves, eliminates two right angle turns which were bad but not dangerous. The present curves are terrible. I have driven a lot, east and south but never, anywhere, have I struck a curve like this one. If this curve is good engineering then all other roads everywhere are wrong.

For Gods sake, do something about it before somebody gets killed.

G. W.

Thirty Years Ago We Remember

When hens were 25 ct. apiece; eggs were two dozen for 15ct.; butter 10 ct. a pound; the butcher gave away liver and treated the kids with bologna. Women didn't smoke, vote, play poker, entertain friends, dance the Black Bottom. Men wore whiskers and boots, chewed tobacco, spit on the sidewalks and cussed. Beer was 5ct. a mug and lunch was free. Laborers worked ten hours a day and never went on a strike, and never read union newspapers. No tips were given to waiters and the hat check grafter was unknown. A kerosene hanging lamp and a stereoscope in the parlor were the height of luxury. No one ever heard of calories, microbes or were ever operated on for appendicitis or bought glands. Folks lived to a good old age and walked miles to wish their friends happiness and success.

THEM DAYS ARE GONE FOREVER.

Says Gov. Browning of Tennessee to Highway Commissioner Allen, following a series of visits from delegations seeking improved roads, "Allen, how much money is invested in our present road system?"

Com. Allen: About $180,000,000, Governor.

Gov. Browning: How much do you suppose it would take to do all the road construction and improvement now being asked?

Com. Allen: I should say around $200,000,000.

Scene: The same.

Time: One week later following a visit from another delegation s. i. r.

Gov. Browning: Allen, what was it you told me would be needed to do the road work we are now being asked for? about $200,000,000?

Com. Allen: Yes, Governor, but that was last week.

Fifteen miles per hour was the first state speed limit in the United States. Connecticut established the precedent in 1901.

ROAD BUILDERS'

FEBRUARY, 1938 AMERICAN ROAD BUILDERS'

Down the Road

By CHARLES M. UPHAM

Engineer-Director,
American Road Builders' Association, Washington, D. C.

GOOD ROADS INCREASE NEWSPAPER CIRCULATION

North, East, West and South meet on common ground and are better understood in the columns of the daily newspaper. Because of daily newspapers, breakfast tables and after-supper periods are enlivened by stories of love, hate and adventure across the sea, in the neighboring state, or in the next town and even across the street.

In order that this end can be achieved, every publisher must solve two problems: First, how to get the news and, second, how to get it to his readers. The first question is answered in a variety of ways. The second is often a difficult one to solve since subscribers may be at a great distance from the newspaper office. To reach subscribers in a town other than that of publication, the United States mails have ordinarily been used. Despite the second-class mailing privilege accorded to newspapers and magazines, this method is expensive. The postal charge averages $1.75 per hundred, an important consideration when we remember the low price of a newspaper. In many cases, the cost of a subscription to an out-of-town paper is nearly doubled because of mailing costs.

Some publishers, however, have found a new method of delivering their product to their readers. They have found that truck distribution of papers costs far less than sending them through the mails. A morning newspaper in upstate New York several years ago effected a saving of $213 per week by leaving the mails and going to trucks for distribution to dealers in nearby communities. The mail cost was $283 per week as against a truck cost of $70 per week. Besides the economy, an earlier distribution was obtained.

Distribution by truck, however, is only possible in areas where roads are good. Recent studies show that the cost of operating a motor-vehicle on a dirt road is more than twice as great as that of operating the same vehicle on a paved road. To the city-dweller, this is unimportant, since his local paper brings him all the day's news. The farmer or small-town resident, however, who wishes the comprehensive news of the war in China, Congressional action, etc., that can be found in the daily paper published in some nearby city, cannot secure this service if the cost of mailing the paper to him is prohibitive. Neither is it possible to send the paper by truck if the roads in his community are unimproved. The construction and maintenance of good roads, however, will permit the distribution of papers at a materially reduced cost and give the rural resident equal opportunity with his urban neighbors to daily keep abreast of world events.

A.R.B.A. ESSAY CONTEST WON BY MISSOURI JUNIOR HIGHWAY ENGINEER

Wallace B. Kane, junior engineer, Missouri State Highway Department, won the all-expense trip to Cleveland for the A. R. B. A. Road Show and Convention for his essay on "The place of the Stabilized Road in Our Low-Cost Highway Program" in the contest sponsored by the American Road Builders' Association among employees of state highway departments.

J. M. Hansen, senior draftsman, state highway department, Olympia, Wash., and Carlisle Nathan Levine, junior civil engineer, state highway department, Boston, Mass., won the two second prizes of $75 each toward the expenses of a trip to the 1938 Road Show-Convention. Two third prizes of $25 toward this trip were awarded to Edwin C. Woodward, division engineer, state highway department, Wichita Falls, Texas, and Ralph E. Davis, designer, state highway dept., Kirkwood, Mo. One hundred and fifty other prizes, consisting of one and two-year memberships in the association, were also awarded in this contest.

FEDERAL AID BILL CALLS FOR SAFETY CODE

The Catright bill for federal aid appropriations for 1940-1941 contains a section providing: "That after two years following the approval of this Act, the Secretary of Agriculture shall not approve any project submitted by any State under the authorizations made in sections 1, 2, and 3 hereof, unless and until, in the interest of safety, he shall find with respect to such State that it has enacted and is enforcing the major requirements of what, in the judgment of the Secretary, constitutes an adequate uniform code for safety in the operation of motor vehicles, particularly with respect to the licensing of drivers and the operation of such vehicles." Another section provides that beginning with the fiscal year ending June 30, 1940 the District of Columbia shall be entitled to share in all sums authorized and apportioned to the States.

REVIEW

Approximately 12 per cent of the motorist's tax dollar creeps into diversion channels.

ASSOCIATION—WASHINGTON FEBRUARY, 1938

A.R.B.A. CONVENTION VOTES OPPOSITION TO FEDERAL-AID HIGHWAY FUND CURTAILMENT

Other Resolutions Point Way to American Road Progress

Unqualified opposition to any reduction in federal aid to highway as well as to any change in the procedure by the American Road Builders' Association at the final session of the association's 35th annual Convention and Road Show in Cleveland. It was pointed out that the federal government has collected from highway users $194,000,000 more than it has expended in federal appropriations for highway improvements. The steadily mounting total of deaths, personal injuries and economic loss by property damage in highway accidents was emphasized as the association adopted a resolution urging Congress to continue federal-aid authorizations, on at least the present level, as provided by the Hayden-Cartwright Road Act of 1934.

Diversion of the money collected by the states in special taxes on the motorists to non-highway purposes was also strongly condemned, as the convention resolved to adopt and follow a definite plan of action to the end of permanently eliminating and preventing diversion of motor-vehicle revenues by constitutional amendments in those states where this has not already been accomplished.

Other resolutions adopted at the convention included an endorsement of federal aid to municipalities to be used on those main arteries which connect state and federal highways; a recommendation that all counties, whenever possible, make use of federal aid for secondary roads to the end that these appropriations be continued; an endorsement of the contract system for use in all highway construction; a pledge to cooperate in every way possible with the recognized groups that are engaged in the education of drivers and which are also working for uniform traffic laws; a decision to work for the early formulation of sound, long-range highway programs by the state highway departments, or state highway planning commissions, and the early adoption of enabling legislation which will place the plans in effect.

ROAD FIGHT STARTS

The Committee of the House of Representatives on Roads at Its First Public Hearing on the Cartright Bill Providing Federal Aid for 1941.

Public hearings on the Cartwright bill for continuing the Federal aid highway program through 1940 and 1941 began last week in Washington before the House Committee on Roads. This picture shows the committee and some of those who attended the first day.

Seated, left to right, are Representatives Nat Patton, Texas; Jesse P. Wolcott, Mich.; J. W. Robinson, Utah; Monrad C. Wallgren, Wash.; Will M. Whittington, Miss.; Lindsay C. Warren, N. C.; Chairman Wilburn Cartwright, Okla.; the first witness, C. H. Purcell, Sacramento, Calif., president, American Association of State Highway Officials; R. J. Sterling, committee stenographer; Representatives James W. Mott, Ore.; Bert Lord, N. Y.; Karl Stefan, Nebr.; Bernard J. Gehrmann, Wis.; Beverly M. Vincent, Ky.; Lewis L. Boyer, Ill.; John Sparkman, Ala., and Orville Zimmerman, Mo.

Back of the committee table, left to right, may be seen Thomas J. Keefe, General Manager, American Motorists Association; Charles M. Upham, Engineer-director, American Road Builders Association; R. B. Brooks, State Highway Commissioner of Missouri; Miss Allene Gingles, assistant committee clerk; Wainwright Bridges, clerk of the Roads Committee; Clyde Edmondson, General Manager, Redwood Empire Assn., San Francisco, Calif.; Chester H. Gray, director, National Highway Users Conference; Raymond H. Coombs, President, National Rural Letter Carriers Association; W. C. Markham, Executive Secretary, American Association of State Highway Officials, and others.

HARMONIC RAIN CYCLES

By HALBERT P. GILLETTE

THE accompanying table gives the lengths and peak dates of 18 basic cycles and the compound cycles resulting from their combination with the annual cycle having its peak at the summer solstice.

It should be noted that all the basic cycles are fractional, and that the harmonic factors in the denominators are 7, 13, and 19, or else 3 or 9 times those numbers. I infer that when the earth was first generated, the harmonic factors were 6, 12, and 18. There is evidence that the sun has lost mass, causing all the planetary periods to lengthen slightly less than 7 per cent. The difference between the factors 12 and 13 is about 8 per cent, while that between the factors 18 and 19 is about 6 per cent.

I believe that solar emission of electrons carrying atoms not only built the planets, but imparted to them their orbital and axial rotations, for electrons emitted in the sun's magnetic field would acquire a spiral motion.

The existence of these 18 weather cycles is probably due to rotation of the magnetic poles of 18 electron-shells that encase the earth. There is evidence of a large number of such shells not only in radio reflections and "echoes" but in the upper regions of auroral display.

In addition to these 18 terrestrial electron-shells the sun apparently has several electron-shells that affect the weather, but usually to a less degree. The sequoia rings and varved silts show a cycle of 78/7=11.14 years, that had a rainfall peak in 1861, and is evidently harmonic with the great sunspot cycle and its accompanying auroral cycle, as well as with the 39-year terrestrial cycle.

It has been recently discovered that the solar corona is a sphere of twice the diameter of the sun's disk. It is, I think, an electron-shell, and the incandescent disk may also be such a shell loaded with atoms. There may be a molten solar-core that rotates in 11.14 years. If so, one or other of its two magnetic poles would be most directed earthward about every 6.6 months. This should cause a rain cycle of 6.6 months. I have found such a cycle having its last peak Oct. 28, 1937.

Study of all the cycles indicates a dry spring in 1938 and a very dry summer in 1940.

The least common multiple of all the cycles in the table is 4,864,860 years, indicating a climatic cycle of that length, with its last peak in 67,714 B. C.

The least common multiple of the first 15 cycles in the table is 25,740 years, with a peak in 16,234 B. C. This is the Ice Age Cycle, and its length is evidently equal to the period of gyration of the earth's axis.

These harmonies are very surprising, yet not more so than many others in nature, notably those indicated by the periodic law of atoms.

The earth's surface is negatively charged with electrons which are constantly being emitted. This would occur if great gravitative pressure converts more electrons than protons into radiant energy. The sun's surface also is negatively charged, and its emitted electrons are believed to be one of the causes of auroras. Even the moon seems to emit electrons, for it affects radio reception as does the sun, although to a less degree. Generalizing from sun, moon and earth, may we not safely infer that electrons in excess of protons constantly escape from all large celestial bodies? Since they must move spirally, they have magnetic polarity. Hence the entire cosmos is a complex of magnetic fields. Who can say what remarkable effect such magnetic systems may cause?

TABLE OF HARMONIC CYCLES

18 Basic Cycles, Lengths in Years		Compound Cycles, Years	Rain Peak or Maximum
1/171 =	2.136 days	1	June 21.5
1/ 57 =	6.408 days	1	June 21.5
1/ 19 =	19.224 days	1	June 21.5
1/ 39 =	9.365 days	1	June 21.5
1/ 13 =	28.096 days	1	June 21.5
3/ 13 =	2.77 months	3	1855
10/ 7 =	1.43 years	10	1855
30/ 7 =	4.29 years	30	1855
10/ 21 =	0.476 years	10	1855
39/ 19 =	2.05 years	39	1861
110/ 19 =	5.79 years	110	1865
180/ 19 =	9.47 years	180	1765
260/ 19 =	13.68 years	260	1705
780/ 19 =	41.05 years	780	1705
2340/ 19 =	123.16 years	2340	145
105/ 13 =	8.08 years	105	1270
315/ 13 =	24.23 years	315	1270
945/ 13 =	72.69 years	945	1270

Note: The least common multiple of any two or more cycles is itself a cycle. The exact peak date of the shortest cycles is at noon (local time) of the northern summer solstice in the meridian of the magnetic north pole. Since the longer cycles are harmonic with them, June 21.5 should be prefixed to each of the years of peak date.

The footnote in the accompanying table calls attention to the fact that the least common multiple of any two or more of these harmonic cycles is a cycle that may be called a compound cycle. Thus, the 1-yr., the 3-yr., the 10-yr., the 30-yr., and the 110-yr. cycles combine to cause an important compound cycle of 210 years. From the peak dates in the table it is readily deduced that the 210-year cycle had its last peak in 1795 A. D. Hence it had a valley in 1900, but since 1900 was a peak date of the 105-year cycle, it follows that it was not a deep valley. Incidentally Del Valle, several years ago, announced the finding of a 210-year cycle in the ancient levels of the Nile. Every one of the last 12 basic cycles in the table has been previously found by one or more researchers, but not with the accuracy as to length needful to show that they are exactly harmonic with the earth's orbital period.

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GASOLINE CONSUMPTION INCREASES IN MINNESOTA—During 1937 in Minnesota gasoline consumption increased 29,000,000 gal., which means 377,000,000 miles of additional travel over 1936.

▼

WHY TRAFFIC ACCIDENT RATE WAS LOWERED—A campaign of education for safety, a stiffening in the enforcement of traffic rules by the highway patrol, stricter courts, the new uniform traffic code and a growing safety consciousness on the part of the public have all contributed to lower the accident death rate in Minnesota, in the opinion of Mr. Rosenwald, head of the new Safety Division.

Toro Power Mower

THE MAINTENANCE OF SHOULDERS AND RIGHTS-OF-WAY

A Review of Problems and Methods in Various States, with Special Reference to the Control of Grass and Weeds. Cost Data Are Given.

The First of Three Installments

By JOHN C. BLACK
Field Editor, Roads and Streets

SAFETY FIRST! Whatever be the importance of Beauty (and its importance is great) or of Convenience (which we all want) or of Economy (necessary, though often abused); our annual grim record of nearly 40,000 fatalities and serious injury to many times that number puts Safety foremost among current street and highway needs. This condition will be bettered in time, but as the causes of accidents are manifold, so must their elimination depend on many and varied efforts.

In the case of shoulders, more accidents are due to faulty design than to poor maintenance, but that maintenance plays its part cannot be denied. Ruts (especially at the slab edge) and sight-obstructing shrubbery on right-of-way at curves and intersections probably are the most prolific accident causes within the control of maintenance forces. Safety, however, is not the subject of this article, and we stress it merely because of its paramount importance.

Second among maintenance considerations comes convenience. No road is truly a good road if it imposes avoidable handicaps on its users; yet we are all familiar with shoulders which are dusty and rough in dry weather —muddy, rough and slippery in wet. And again, though the primary fault may lie with design or construction, a practical improvement is possible under maintenance.

I believe that most people will concede a value to beauty generally, but many are never quite willing to pay for it specifically. They accept a lovely roadside with more or less gratitude to Mother Nature, but balk at helping the old lady out with a few dollars to cover a blemish or develop a beauty spot. They can think of too many "practical" uses for that money. Fortunately this attitude is changing, and reasonable appropriations for landscape work are now common in spite of objections. In what follows there are numerous references to roadside improvement.

The mowing of shoulders and other areas, though not

Adams Leaning Wheel Grader No. 84

Typical Slope and Shoulder Maintenance with Pull-Type Grader. Note the Rut Next to Pavement, Which Will Be Filled on Another Round. This Was a Wet Day, But a Good One for This Kind of Work.

usually classed as beautification, contributes much to that end, for an untidy right-of-way creates the same unfavorable impression as an untidy yard around a house. This is by no means to say that every piece of right-of-way should be finished and maintained to look like a city park. There is a place for the cultivated and a plan for the natural, and good taste alone can decide each case.

An initial reference to economy having been made, some elaboration might be considered in order; but the necessity of economy is so obvious and its working out so complicated, that any attempt at discussion in a few words is useless. Economic analysis of shoulder and right-of-way maintenance must recognize the competition for funds, not only with all other maintenance activities, but with such items as police patrol, administration, and even construction. We hope to present a study of this sort in a future issue.

The states from which observation and experiences are here reported vary widely in geographical location, topography and climate. Yes, and we should add, wealth. Therefore the method most satisfactory in one state or one part of a state may not be best elsewhere; and especially, the unit cost may vary from place to place. While it is, of course, impossible to cover all conditions within the scope of a single article, the variety here presented should furnish matter of interest to almost every maintenance engineer and superintendent. in addition to which there is the ever-present possibility of adaptation of methods with minor changes from one set of conditions to another.

It is noteworthy that the departments find such variations in local conditions as to warrant the use of a variety of mowing equipment.

The information following was very courteously contributed by state highway and maintenance engineers:

Michigan

The two methods used by the Michigan State Highway Department in keeping down weeds along shoulders of the highways are mowing and dragging. When the shoulders are dragged, however, the mowing function is secondary.

Dragging

The primary function of dragging is to smooth out ruts and to keep the shoulders in good condition. Weeds are removed at the same time. Shoulders are dragged from four to ten times each year depending upon the use of the road.

Two men with a truck and shoulder maintainer will drag about ten miles a day. The dragging cost is approximately $1.75 per mile each time the shoulders are dragged on each side of the road.

Mowing

The department reports that it has found the most satisfactory combination for mowing to be a tractor with mowing machine attached. With such a combination the mowing machine can be manipulated around trees, guard rails, etc., more easily than other types of tractor equipment. A number of companies manufacture such a machine.

Comparison of Equipment.—When the mowing machine is pulled behind a tractor or truck, two men are required to operate it. This combination cannot be used for all types of mowing, because it is more difficult to manipulate the tractor and machinery than it is the combination with the mowing machine attached.

The horse-drawn machine is satisfactory and economical when it can be obtained. Roadside mowing, however, comes at a time when farmers are busy and it is difficult to secure horse-drawn machines, thus making them generally impractical for this work.

The ideal mowing machine combination is one which will mow the maximum amount of the roadside leaving a minimum for hand mowing.

Costs.—The shoulders of the road are usually mowed four times a year. The average cost is $12.00 per mile per year. One man operating a tractor with mowing machine attached can efficiently mow about 22 miles in a 10-hour day, or make two complete trips on a 5½ mile stretch of road.

A complete mowing of the roadside will include four mowings of shoulders and two complete mowings of the entire right-of-way each year at a cost of from $30.00 to $60.00 per mile depending upon the width of the right-of-way and the amount of hand mowing that is necessary between the ditch and the right-of-way line.

Chemicals Not Used.—Chemical are not used for weed control in Michigan, for the reason that they are apt to kill the grass as well as the weeds.

Toro Manufacturing Co.

Cutting Behind Guard Rail with a Two-Wheeled Mower Attached to Truck.

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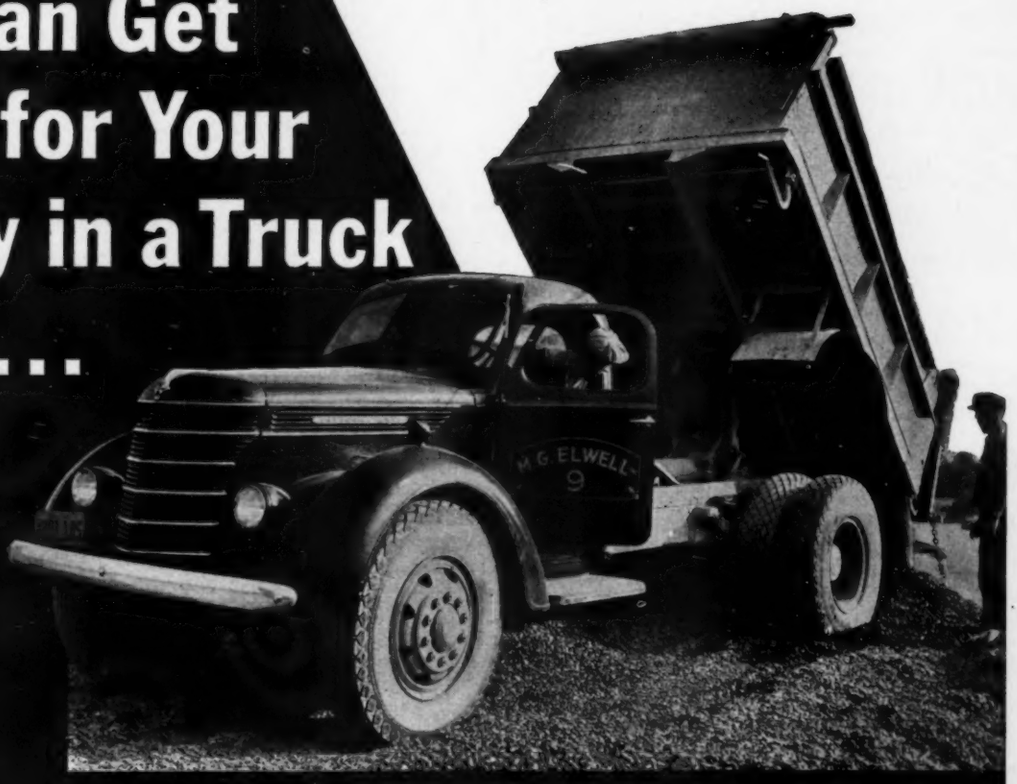

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INTERNATIONAL TRUCKS

Illinois

The Illinois State Highway Department mows all highways from fence line to fence line twice during the summer season, and in addition mows the shoulders and shoulder slopes of the ditches once. The first mowing is in a general clean-up of the entire right-of-way for the purpose of cutting weeds before the seeds mature sufficiently to germinate.

The second mowing is usually confined to the shoulders and shoulder slopes of the ditches and to areas badly infested with weeds.

The final mowing is done late in the fall, and is a cocmplete clean-up from fence to fence. In addition to improving appearance and making maintenance work easier, it also helps to lessen snow drifts. There are variations from the established program due to rainfall, plant growth, type of vegetation, and local conditions.

Climatic Variations Affect Time and Methods of Mowing.—There is a considerable difference in climate and rainfall between the northern and southern parts of the State, which affects plant growth and the time at which the mowing is done. There is a month's difference in season, and in spite of all efforts which have been made by the Department, it is difficult to get the desired appearance of the highways throughout the State at the same time.

The first mowing usually occurs about the time farmers are busy with their planting and plowing, making it difficult to get teams. This condition does not exist, however, during the second and third mowings.

The Highway Department cooperates with the Department of Agriculture in the destruction and control of noxious weeds in compliance with the agriculture laws.

Types of Equipment.—A large number of ordinary horse drawn farm mowers are used, some of which are rented, and some of which are owned by the State. Farm type mowers with truck hitches are also fastened behind the patrolmen's trucks, and a considerable amount of the shoulder mowing is done in this manner. In addition to this the State owns a number of motor driven mowers of various types. These are used in areas where teams are not available.

Average Costs.—The cost per mile of highway mowing varies with topography, width of right-of-way, growth of vegetation, rainfall and other causes. The average cost per mile for cutting and clearing vegetation on all State highways for 1935 amounted to $57.08, and the cost for 1936 was $43.15 per mile.

International Mower with Power Take-off on Tractor

Mowing a Weed-Grown Right-of-Way in Michigan.

Case Mower with Power Take-off on Tractor

Cutting the Tall Growth on Shoulder Slope.

Missouri

On all gravel and stone surfaced roads, and on oil mat and flexible bituminous type surfaced roads the shoulders and shoulder slopes are bladed and dragged frequently to kill grass and weeds and afford proper maintenance.

On roads having concrete or other rigid type surfaces, the growth of grass on the shoulders, in-slopes, back-slopes and, in fact, the entire right-of-way, is encouraged. The growth of a good sod from the edge of the slab to the right-of-way line decreases the cost of maintenance and makes a good looking right-of-way.

Two Clean-Ups Per Year.—In order to keep down the weeds and keep the grass properly cut on the State system, it is necessary to have a full right-of-way clean-up twice each year, at which time the entire right-of-way from the edge of the slab to the right-of-way line is mowed. This work is usually done in June and again in September on all State routes. On the gravel surface, crushed rock surface, and flexible bituminous surface roads on the State highway system, this work is done twice a year also, in order to control the growth of weeds and keep the grass cut between the back-slopes and the right-of-way line.

On the supplementary system a full right-of-way clean-up is made once each year, usually in August.

Additional Mowings.—On roads having rigid type surfaces it is necessary to mow the shoulders and shoulder slopes several times, in addition to the mowings during full right-of-way clean-up. The number of such extra mowings depends upon the season, as the weather controls the growth of vegetation.

Horse-Drawn Mowers Favored.—In mowing grass and weeds on the right-of-way, team-drawn mowers are used as much as possible, since the Department considers this to be the most economical method it has found. However, use is also made of mowers pulled behind trucks and tractors, as well as mowers operated with power take-off from the tractors.

Costs.—A team-drawn mower ordinarily can cut the full width of a 60-ft. right-of-way outside the slab for a distance of 1½ to 2 miles in a day's time, if the back-slopes have been laid back so that the team can operate over the full width of the right-of-way. If very little hand work is required in addition to the team and

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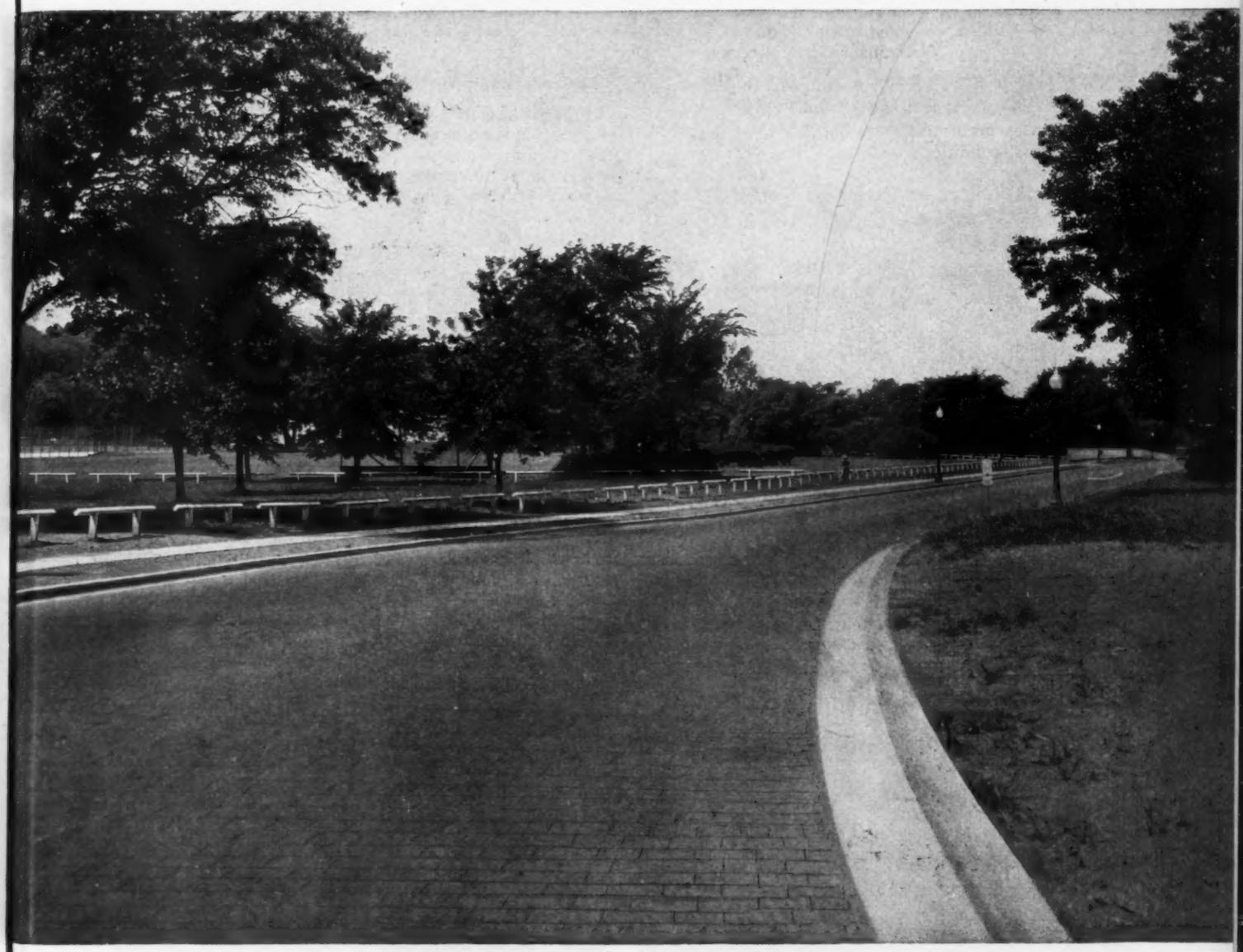

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NATIONAL PAVING BRICK ASSOCIATION, National Press Bldg., Washington, D. C.

mower, the cost of mowing a right-of-way in this way ranges usually between $3.00 and $4.00 per mile for each cutting.

If the back-slopes have not been laid back, and it is necessary to do considerable hand work in cleaning the right-of-way, the cost of this work will run from $10.00 to $15.00 per mile for each full right-of-way cutting.

The mowers pulled behind trucks or tractors can be used as a rule only for cutting the shoulders and shoulder slopes, and it is then necessary to use team-drawn mowers on the remainder of the right-of-way. A mower pulled behind a truck or tractor usually operates at a speed of about four miles per hour and makes a cut of five, six, or seven feet, depending upon the length of the cutting bar.

Wisconsin

Shoulder and right-of-way maintenance in Wisconsin consists of principally in dragging and mowing—the operations varying according to traffic, character of surface and other local conditions.

A Bituminous Treated Shoulder in Wisconsin.

Dragging

The heavily traveled concrete highways have gravel shoulders, which are dragged frequently to maintain a smooth surface, prevent erosion and promote safety.

A Neat Job with Truck-Type Mower.

Some shoulders are dragged every day—others once or twice a week—the frequency depending on volume of traffic, type of traffic, etc. This dragging, however, is not done to keep down weeds, as there are neither weeds nor grass on this type of shoulder.

Hand Mowing of Weeds in Wisconsin.

Bituminous Treatment

In places where heavy traffic leads to considerable turning out on shoulders for passing or other purposes, thus making it impractical to maintain a good, safe surface of untreated stone or gravel, the shoulder is matted down with bituminous material.

Mowing

Ungravelled shoulders are sodded, and these are mowed as often as necessary, the period between mowings being governed largely by weather conditions, character of soil, etc. A conspicuous difference is noted in the rate of growth on the rich soils in some parts of the State and the poor soils predominating in others.

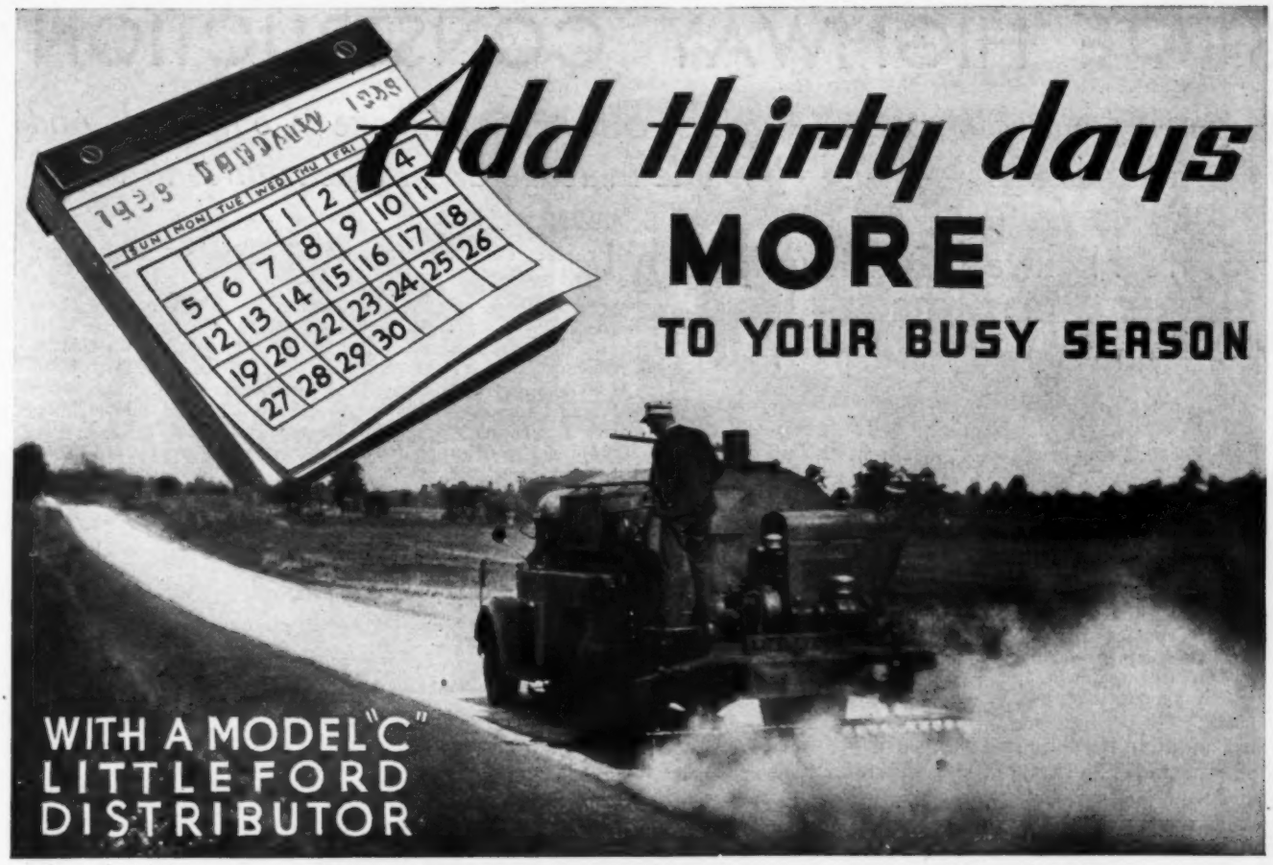
Slopes and Ditches.—Ditches, and the slopes to the ditch line, are mowed as often as the shoulders. The slope from ditch to fence is usually mowed once a year; that is, in the fall to prevent the drifting of snow. In addition to this, noxious weeds are cut as required by law, the work being done by hand by the patrolman.

Machines, Methods, Cost.—Most of the mowing is done by machine—either a farm mower drawn by a light truck, or a special highway mowing machine. Horse-drawn mowers, however, are used to a considerable extent in localities where teams are available at a reasonable price. All of these methods are satisfactory. Around bridge walls and guard rails the patrolman mows by hand ahead of the machines.

On the State Trunk Highway System, the average annual cost for mowing and keeping the right-of-way clear of brush, grass and weeds is approximately $23.00 per mile. This cost, however, varies considerably with soil and other conditions.

(*To be continued in March*)

Dobbin Is Still with Us.



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STATE HIGHWAY CONSTRUCTION

Reports from Highway Officials Showing Mileage Completed and Expenditures in 1937 and Probable Mileage and Expenditures in 1938

State Highway Construction 1937-1938

IN THE January issue of ROADS AND STREETS (pages 58-74) there were reports from 41 states showing the mileage of state highway completed in 1937, and the outlook for state highway construction in 1938. Reports received too late for inclusion in the above issue follow:

Florida

State highway construction costing $9,235,331 was completed in 1937. The mileage by types was as follows:

Types	Miles
Graded and drained	149
Sand clay surface treatment	98
Rock base surface treatment	30
Marl surface treatment	3
Sand bituminous road mix	55
Concrete	26

In addition 10 bridges having an aggregate length of 2,839 ft. and 12 grade crossing eliminations were completed.

The uncompleted contracts carried over to 1938 included the following: Concrete, 7 miles; sand-clay surface treatment, 21 miles; rock base surface treatment, 11 miles; marl base surface treatment, 3 miles; sand bituminous road mix, 9 miles.

The approximate amount available for new construction in 1938 is $7,156,000; for maintenance, $3,300,000; for other purposes, $517,000.

Georgia

The approximate mileage and estimated cost of the highway work for which contracts have been issued during 1937 were as follows:

	Miles	Estimated Cost
Paving and bridges	506	$ 8,542,000
Grading and bridges	600	7,227,000
34 grade crossing elimination projects	....	1,424,000
10 grade crossing protection projects	....	59,000
Total	1,106	$17,252,000

Total number of bridges, 74.
Total number of grade crossing elimination projects, 34.
Total number of grade crossing protection projects, 10.

The State Highway department will have available for 1938 construction program approximately $11,000,000 federal funds, but no estimate has been made of the amount of state funds which will be available for construction during 1938. However, it is believed that the funds for 1938 will be approximately the same as for 1937.

Idaho

The following tabulations outline the work of the Bureau of Highways of the State Department of Public Works:

Projects contracted in 1936 and completed in 1937:

Grade and drain	3.4 Miles
Grade, drain, and crushed rock or gravel surface.	13.9 Miles
Crushed rock surfacing	6.5 Miles
Plant mix bituminous mat surface	43.9 Miles
Paving—concrete or macadam	8.9 Miles
Concrete and steel overheads	695 L. F.

Projects contracted and completed subsequent to Jan. 1, 1937 and prior to Dec. 1, 1937:

Grade and drain	13.4 Miles
Grade, drain, and pit run gravel subbase	8.6 Miles
Grade, drain, and crushed rock or gravel subbase.	21.4 Miles
Crushed gravel surface	41.1 Miles
Crushed gravel in windrows for bituminous mat.	81.8 Miles
Road mix bituminous mat	166.6 Miles
Plant mix bituminous mat	38.7 Miles
Bituminous penetration treatment	25.6 Miles
Bituminous surface, warcolite	0.9 Miles
Roadside improvement	1.7 Miles
Concrete grade separation structures	248 L. F.

Projects contracted in 1937 but not completed Dec. 1, 1937:

Grade and drain	2.9 Miles
Grade, drain and crushed rock or gravel surface.	79.2 Miles
Gravel subbase	21.7 Miles
Crushed gravel surface	12.5 Miles
Road mix bituminous surface	13.5 Miles
3 concrete bridges	468 Ft.
Concrete and steel overheads	1,369 Ft.
1 concrete and steel underpass	51 Ft.

Projects advertised to be let during month of December, 1937:

Grade, drain and crushed rock or gravel surface.	7.8 Miles
Roadbed and drainage structures	3.5 Miles

Approximate total amounts of money available for highways during 1938:

Maintenance	$1,600,000
New construction	4,560,000
Miscellaneous	840,000
Total	$7,000,000

Sources from which money may be available and approximate amount of each:

Federal Funds (Depending on Congressional Action)—		
1. Federal aid	$1,842,000	
2. Federal lands	132,000	
3. Grade separation	418,000	
Subtotal		$2,392,000
State Funds—Estimated—		
1. State gasoline tax	$4,330,000	
2. Motor vehicle license fees and other	278,000	
Subtotal		$4,608,000
Total		$7,000,000

Mississippi

A total of 1,275 miles of state highway was completed in 1937, the mileage by types being as follows:

Types	Miles	Total Cost
Concrete	364	$ 8,552,671
Asphalt	37	485,158
Bituminous surface	20	189,848
Gravel	57	145,691
Grade and drain	769	10,532,954
Sand, asphalt	28	388,967

In addition 347 bridges of an aggregate length of 10.8 miles and costing $4,239,339 were completed. Grade crossing separations to the number of 19 also were completed.

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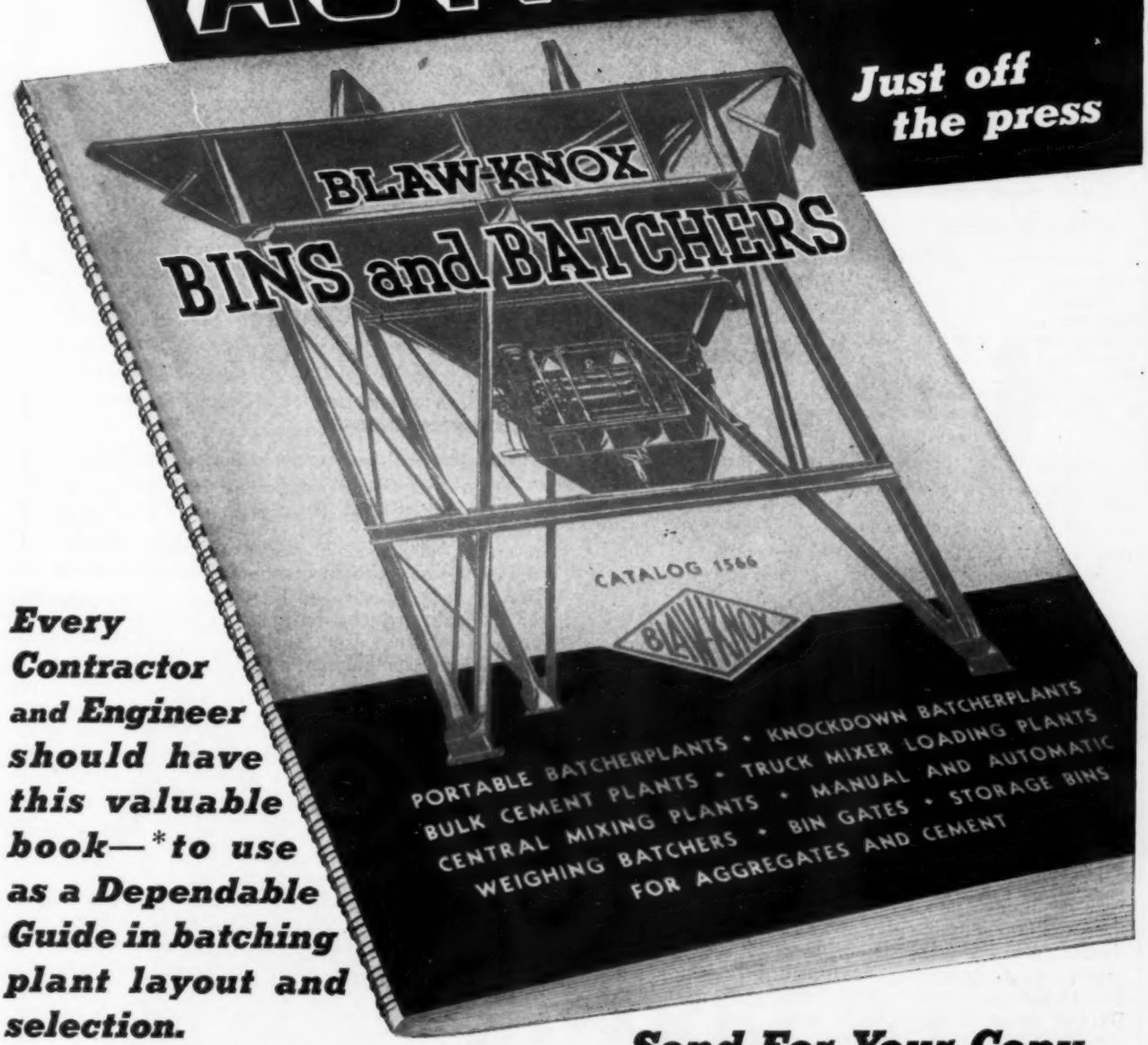
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The uncompleted contracts carried over to 1938 were as follows:

Types	Miles	Cost
Grade and drain	462	$7,005,264
Concrete	343	7,934,497
Asphalt	62	1,144,544
Bituminous surface	19	225,163
Sand clay topping	29	103,008
Bridges, 208	6.22	2,694,754

The legislature is now working out the new construction program for 1938.

Ohio

State highway totaling 619 miles was completed in 1937. The mileage by types was as follows:

Types	Miles	Total Cost
Cement concrete	40	$2,961,496
Asphalt surface treatment	463	5,468,536
Gravel and stone	122	1,269,299
Graded and drained	15	338,262
Roadside improvement	...	58,126
Brick	25	2,621,714
Miscellaneous	25	377,052
*Bridges and approaches	...	.....
18 grade crossing eliminations	9.456	2,085,958

*Included in highway contracts.

Uncompleted contracts carried over to 1938 were as follows:

Types	Miles	Cost
Concrete	54	$3,279,491
Asphalt surface treatment	159	2,722,691
Gravel and stone	20	1,027,444
Tar, concrete	4	69,734
Bridges and grade crossings	15	5,532,021
Roadside improvement	5	26,368
Brick	31	3,492,939

The amount available for construction in 1938 is $15,200,000, which is approximately the same as for 1937. For maintenance $12,270,000 has been appropriated. The amount for purchase of new equipment had not been determined.

The proposed construction for 1938 is as follows:

PROPOSED CONSTRUCTION

Types	Miles	Probable Cost
Grading (no separate projects)	...	.....
Stone or gravel surfacing	101	$ 820,000
Concrete	59	4,900,000
Bituminous types (not determined)	...	.....
Stabilization	22	310,000
Roadside improvement	120	300,000
Bridges (approximate)	...	2,000,000
Grade separations	13	2,141,000

Pennsylvania

The State Highway department operates on a fiscal year beginning June 1 of each year, and at the present time it is impossible to give any indication as to the work that can be undertaken after June 1, 1938. During the present fiscal year the department is expending some $65,000,000 on construction, and approximately $37,500,000 on maintenance.

West Virginia

During 1937 the State Road Commission awarded 111 road contracts, the total of the contents being $4,312,708; 19 bridge contracts, $1,054,210; and 12 miscellaneous contracts, $133,333. Of the 111 road contracts 255.9 miles were on primary roads, costing $3,508,548; and 194 miles on secondary roads, costing $804,160.

The bridge and miscellaneous road contracts awarded during 1937 were as follows:

No. of Contracts	Type of Construction	Primary	Secondary	Total
19	Bridges	$1,022,820	$31,390	$1,054,210
6	Hauling stone base	55,204	.....	55,204
5	Guard rail	76,478	.....	76,478
1	Flasher signals	1,651	.....	1,651
31	Totals	$1,156,153	$31,390	$1,187,543

The following is a summary of types of construction awarded in 1937:

Types of Construction	Miles Primary,	Miles Secondary,	Miles Total
Grading and draining	64.549	6.743	71.292
Slag surface	2.930	.....	2.930
Shale surface	4.520	.....	4.520
Gravel surface	4.075	.....	4.075
Macadam base	64.033	6.180	70.213
Reconstruct base	9.323	117.707	127.030
Processed sandrock asphalt surface	6.723	.....	6.723
Stabilization	.....	2.800	2.800
Surface treatments	95.550	146.530	242.080
Class "H" surface	10.294	.....	10.294
Road mix surface	80.880	44.957	125.837
Asphalt concrete surface	8.775	.....	8.755
Penetration macadam	7.554	.....	7.554
Widen and resurface with cement conc.	.111	.....	.111
Cement concrete pavement	22.845	.....	22.845

Detailed information is not available at this time as to the 1938 construction program. It is contemplated, however, that the total amount of construction will be approximately equal to that of the 1937 program.

▼

Irven E. Stevenson

True, no man lives or dies to himself alone, but a few—a very few—live the good life, the generous life, the full life to a degree that leaves literally hundreds of mourners when they pass. Such a one was Irven E. Stevenson, advertising manager of Pacific Builder and Engineer, who, with nine others, met death in an airplane crash in Montana on January 10. It was no single trait or quality which won him this position: some loved him for one thing—some for another—and many for his extraordinary combination of cosmopolitanism, sincerity, kindliness and business ability. Literally, he was known from coast to coast among the advertising and construction fraternities and many others. Only a few weeks before his death he paused for an hour in our office, discussing impartially business matters of common concern and the lighter interests of off-business hours. We prize the memory of that visit.

▼

HIGHWAY ENGINEERS OF MICHIGAN UPPER PENINSULA TO MEET.—The annual meeting of highway engineers and commissioners of the Upper Peninsula will be held April 1 and 2. The conference will take place at the Michigan College of Mining and Technology. The annual meeting is sponsored by the state highway department in cooperation with the College of Mines and the Upper Peninsula Road Builders' Association. State Highway Commissioner Murray D. Van Wagoner has appointed W. W. McLaughlin, research and testing engineer of the state highway department, as general chairman of the conference. Other members of the committee are: P. N. Thornton, Hancock, contractors; C. F. Winkler, Houghton County road engineer; Prof. N. F. Manderfield, of the College of Mines; and Ben F. Sparks, Escanaba, Upper Peninsula engineer for the state highway department.

Barber-Greene Line for Road Construction

MIXER

Mixes Bituminous and stabilized materials. Used as Central Plant or towed by Bucket Loader as Travel Plant. Gives accurate proportioning, thorough mixing. Continuous operation gives high capacity. Complete mechanical control of all operations produces uniform results without increasing costs. Short mixing cycle permits work in colder atmospheric temperatures, lengthening working day and season. Complete, highly portable, versatile.

FINISHER

Receives material from travel plant or truck. Gives smooth surface without the use of forms. B-G leveling principle far superior to long shoes or long wheel base. Can work to surveyed levels. Finisher levels and compacts simultaneously, thus automatically feeding correct amount of material for level compacted thickness. Tamping gives a permanent, more uniform density regardless of base irregularities and consequent variations in mat thickness. Tamping greatly reduces and simplifies rolling. Thickness and crown easily altered while operating, but sudden changes impossible. Foolproof.

LOADER

Valuable versatility describes the Bucket Loader. It tows the Mixer, forming the Travel Plant, picking up the aggregate from the windrow on the road and feeding it to the hopper of the Mixer Unit. It works independently, loading the aggregate from stock piles to trucks. Ideal for light stripping and excavating. It can be equipped with grizzlies or vibrating screens. Its accuracy makes it excellent for subgrade and shoulder preparation and clean-up. Rated at 2 to 3 cubic yards per minute, it is not restricted to bituminous work, but is a valuable tool all year.

AUXILIARY EQUIPMENT

Barber-Greene Auxiliary Equipment includes Portable Driers, Clay Disintegrators, Belt Conveyors, Ditchers, Screens, Bins, Feeders, etc. Write for details. There is no obligation.

38-I

BARBER GREENE

510 West Park Avenue
AURORA, ILLINOIS

ROAD SHOW AND CONVENTION

FOLLOWING each convention and show of the American Road Builders' Association, it has been the custom of ROADS & STREETS to present a fairly comprehensive illustrated account for the benefit of those among its readers who did not attend. This year we depart from that custom for the simple reason that the affair was too big for satisfactory presentation in a single issue. Pictures alone, if we were to cover the exhibits impartially, would require more page space than is available; and any detailed written account would meet the same difficulty. We regret this, for while neither type nor pictures can convey the inspiration of the occasion, they give at least a suggestion of what was there.

A few generalities, however, may be of interest. The show was an all-time record breaker in floor area occupied, value of exhibits, and attendance (approximately 28,000). In the opinion of the writer, it was a record breaker likewise in interest and attractiveness of displays, and in the interest and enthusiasm of both visitors and exhibitors. Furthermore, and certainly not least important, there were indications that more business was transacted—more actual sales made—than at any previous show.

The spirit of optimism developed as show and convention progressed. A good many admittedly came with misgivings for the immediate future of road building, but either the enthusiasm of others or the sight of new and attractive tools won them over, till at the close it was all, "Hip, Hurrah, Boys: Let's Go!"

The campaign to save Federal appropriations is progressing well; (it was the foremost topic of conversation at Cleveland), but it is not yet won; and until the victory is definite, any relaxation of effort is dangerous. Comparison with the over-confident football team is trite but apt. As for the general run of flies in the road builder's soup, they will probably be no larger or more numerous than in a normal year—whatever that is—and we have a fair hope that the labor bug will be less pestiferous than in 1937.

As to equipment shown, it was notable that the long-time tendencies to improve quality and develop variety continue. Greater strength and better mechanical finish were evident in display after display. Also, the development of both automatic and manual control were most conspicuous. When one considers the machines of even six or eight years ago, the precision and completeness of the work done by a single modern unit is astounding. Then there were the many minor units for use in special operations, and the attachments for improving convenience, performance or quality of work done by major machines.

Honors probably should go to the big concrete pavers for attracting more attention than any other single class of equipment. Several 34-E's and one 40-E mark a pretty radical revolution from the long reign of the 27-cu. ft. unit. Will the revolution go farther?

Two hundred and twenty-four manufacturers in all had displays—many of them of astonishing size and variety. In addition there were 21 educational exhibits by various organizations, including nine state highway departments.

We wish that every road builder—from mucker to commission chairman—might have seen this exhibition, for inspiration was there, and new ideas, and fellowship.

The Convention

THE vividness of the exhibition hall so holds attention that road show and convention tend to become synonymous, and the business and technical sessions of the American Road Builders' Association practically forgotten, by many who attend these biennial affairs. But while there is good reason for this wider interest in the spectacular, it should not be accepted that the other phases are less valuable or important.

Technical Sessions

The professional, or technical, meetings of the Association bring out the latest developments and prospects in practically all phases of road work, and provide opportunity for needed discussion. With rare exceptions they are packed with interest for those who attend, and they usually run as long as time permits. One or more sessions was devoted to each of the following subjects or group interests:

Stabilization.
Safe Highways.
Highway Contractors.
State Highway Officials and Highway Contractors.
Drainage.
County Highway Officials.
Municipal Officials.
National Highway Advisory Council.
Diversion of Revenues.
Highway Education.
Pan American Highway Affairs.

A list of the officers presiding at these sessions, the titles of papers presented and the authors of papers was given on pages 48 and 49 of the January issue of ROADS AND STREETS. Some of these papers will be reproduced in later issues.

Business Meetings and New Officers

All official business was transacted at regular meetings of the Association and its various divisions. New officers were elected as follows:

Pres., Murray D. Van Wagoner,
State Highway Commissioner,
Lansing, Michigan

Vice Pres., Northeastern District
Paul B. Reinhold,
Reinhold & Co.,
Pittsburgh, Pa.

Vice Pres., Southern District
E. D. Kenna,
Director, Mississippi State Highway Dept.
Jackson, Miss.

Vice Pres., Central District
Lion Gardiner,
Jaeger Machine Co.,
Columbus, Ohio

Vice Pres., Western District
Stanley Abel,
Taft, Calif.

Treas., James H. MacDonald,
New Haven, Conn.

Directors.—Directors for the next two years will be A. W. Brandt, commissioner of highways, department of public works, Albany, N. Y.; Carl W. Brown, chief engineer, Missouri State Highway Department, Jefferson

You CAN BANK ON THE 3/4 CUBIC YARD MARION EVERY TIME . . .

"Naturally I was critical in selecting my first power shovel. I wanted speed, dependable performance, simple operation and chief of all . . . low maintenance. I have found everything I wanted in my Marion Type 331-3/4 cu. yd. shovel," says I. J. Lebold, Mineral City, Ohio.

A powerful and compact unit, built to work in close clearances, the type 331 Marion 3/4 cubic yard shovel is a machine on whose speed, power and performance you can bank any time . . . under any operating condition. Being readily convertible and due to its mobility, it is also admirably fitted for crane or dragline service. See it on the job . . . or write for additional information.

● There is a Marion for every material handling job. » » »

The MARION STEAM SHOVEL COMPANY, • MARION, OHIO

City; Frederick Hoitt, secretary, New England Road Builders' Association, Boston, Mass.; C. J. Sherlock, first assistant engineer, Alabama Department of Highways, Montgomery; Charles M. Upham, engineer-director of the A.R.B.A., Washington, D. C.; Charles D. Vail, state highway engineer, Denver, Colo., and H. C. Whitehurst, director of highways, Washington, D. C.

William P. McDonald, Flushing, N. Y., and William R. Smith, Meriden, Conn., were elected president and vice-president, respectively, of the Highway Contractors' Division of the association.

Associated Equipment Distributors Convention—1938

INDICATING the importance of road construction and maintenance in the equipment industry, the Associated Equipment Distributors held their annual meeting at Cleveland, Ohio, on January 15th and 16th, the two days immediately preceding the opening of the A.R.B.A. convention and show.

Not only was this the largest meeting held by the distributors in many years, but it was rated by those in attendance as distinctly the most successful. As an indication of the interest taken, it was noted that attendance increased regularly and continuously from session to session throughout the two days. Among the highlights was the luncheon on Sunday in honor of the past presidents, each of whom was presented with a bronze plaque commemorative of his services to the organization.

In addition to the transaction of business affairs, the following papers were presented and discussed:

Reports of Special Committee on Robinson-Patman Test Case:
C. G. Borchert,
Borchert Ingersoll Co., St. Paul

"What a Contractor Has a Right to Expect from a Distributor"
San Pace, General Asphalt Co., Canton, Ohio

"Satisfied Customers and Service Policies"
H. H. Hoppe, Service Manager,
Wm. H. Ziegler Co., Minneapolis

"Rental Operations and Policies"
G. H. Jamison, A. H. Cox Co., Seattle
E. M. Farnum, Geo. F. Smith Co., St. Louis, Mo.
H. E. Shaw, Service Supply Corp., Philadelphia

"The Manufacturer—The Distributor and Governmental Sales"
M. R. Hunter, Hunter Tractor & Machinery Co.
Milwaukee, Wisconsin

"What a Manufacturer Has a Right to Expect from a Distributor"
R. T. Harris, Manager, Construction Equipment Department, Blaw-Knox Co., Pittsburgh

"What a Distributor Has a Right to Expect from a Manufacturer"
H. W. Fletcher, Fletcher Equipment Co.,
New Orleans

"Truck Mixer Monkey Business"
R. G. Folz, Blaisdell-Folz Co., Cincinnati, O.

"An Idea from My Business"
A. F. Sersanous, Loggers and Contractors Mach. Co., Portland, Oregon
D. I. Cooper, Howard-Cooper Corp., Portland
Victor L. Phillips, Victor L. Phillips Co.,
Kansas City, Mo.

"So What"
G. F. Lowe, President.

Officers and directors were elected as follows:

Pres., A. F. Sersanous,
Loggers' and Contractors' Machinery Co.,
Portland, Ore.

First Vice Pres., Victor L. Phillips,
Victor L. Phillips Co.,
Kansas City, Mo.

Second Vice Pres., R. R. Nixon,
Nixon-Hasselle Co.,
Chattanooga, Tenn.

Sec'y-Treas., A. C. Blaisdell,
Blaisdell-Foltz Equipment Co.,
2143 Barnard St.,
Cincinnati, Ohio

Directors to Serve Three Years:

E. K. Hurst,
Western Material Co., Sioux Falls, S. Dak.

Morton Hunter,
Hunter Tractor & Machinery Co.,
Milwaukee, Wis.

Holdover directors are:

G. F. Lowe,
Lowe Machinery Co.,
Chicago, Ill.

E. S. Jenison,
Jenison Machinery Co.,
San Francisco, Calif.

E. P. Phillips,
Phillips Machinery Co.,
Richmond, Va.

Progress of Highway Planning Surveys

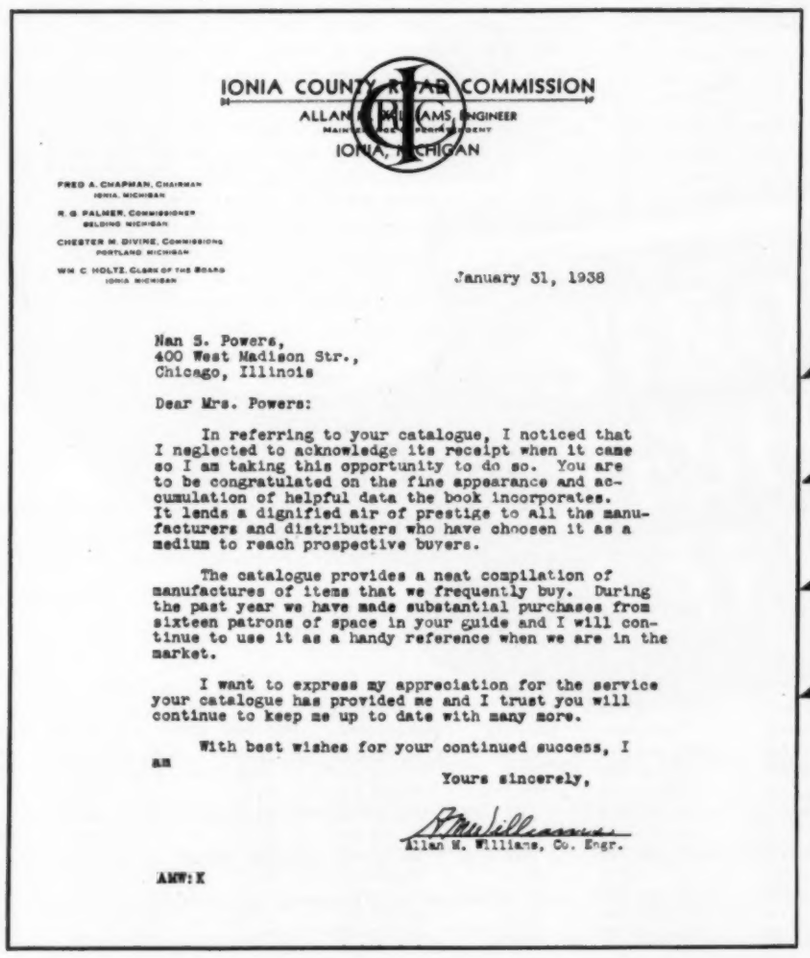
Good progress has been made with the fact finding highway planning surveys now being conducted by the U. S. Bureau of Public Roads in cooperation with 44 states. According to a paper presented last month at the 35th annual convention of the American Road Builders Association by H. E. Hilts, Assistant Chief, Division of Highway Transport of the U. S. Bureau of Public Roads, to Jan. 1, 1938, in the 44 co-operating states, about 80 per cent of the 2,900,000 miles of the rural highways had been inventoried. Curvature, superelevation, sight distance, and grade surveys were completed on 70 per cent of the 326,000 miles of the main traffic arteries scheduled for coverage.

Drafting work on 2,981 county base maps was 52 per cent complete. There will be 3,875 sheets in this county series which will serve as base maps for road type, transportation and land use maps. Two hundred and forty-eight county maps have been approved. Straight-line diagrams are now being prepared on about 420,000 miles of the state highway systems and it is estimated that this work is about 75 per cent complete. These maps show the center line of the highway as a straight line with the customary railroad method of denoting curavture and with parallel lines to denote grades. They show culture and bridges as well and can be expanded to be used by the maintenance and traffic divisions to show road damage, traffic signs and signals, establish preliminary programs for betterments, to keep visual records of yearly maintenance operations, show types of pavement, width of right of way, and roadside drainage structures. They may be used to plot accurate accident spot maps for field study of accidents and will become more valuable year by year as the accident records accumulate.

POWERS' ROAD AND STREET CATALOG

IS THE HIGHWAY TO RESULTS!

It Assures Its Space Users



IONIA COUNTY ROAD COMMISSION
ALLAN M. WILLIAMS, ENGINEER
IONIA, MICHIGAN

FRED A. CHAPMAN, Chairman
IONIA, MICHIGAN
R. G. PALMER, Commissioner
BELDING, MICHIGAN
CHESTER M. DIVINE, Commissioner
PORTLAND, MICHIGAN
WM. C. HOLTZ, Clerk of the Board
IONIA, MICHIGAN

January 31, 1938

Nan S. Powers,
400 West Madison Str.,
Chicago, Illinois

Dear Mrs. Powers:

In referring to your catalogue, I noticed that I neglected to acknowledge its receipt when it came so I am taking this opportunity to do so. You are to be congratulated on the fine appearance and accumulation of helpful data the book incorporates. It lends a dignified air of prestige to all the manufacturers and distributers who have choosen it as a medium to reach prospective buyers.

The catalogue provides a neat compilation of manufactures of items that we frequently buy. During the past year we have made substantial purchases from sixteen patrons of space in your guide and I will continue to use it as a handy reference when we are in the market.

I want to express my appreciation for the service your catalogue has provided me and I trust you will continue to keep me up to date with many more.

With best wishes for your continued success, I am

Yours sincerely,

Allan M. Williams, Co. Engr.

AMW:K

PRESTIGE
PERMANENCE
SALES
SERVICE

The 1938 edition is now in preparation and will be issued early this year. Reservations for space should be made at once.

Powers' Road and Street Catalog and Data Book

400 W. Madison St., Chicago **155 E. 44th St., New York**

Local Road and Street Financial Problem

AT THE recent meeting of the Highway Research Board, Mr. T. H. MacDonald, Chief, U. S. Bureau of Public Roads, presented a paper to the Department of Highway Finance in which he discussed, "Problems of Financial Administration with Special Reference to Local Roads and Streets." He summarized his paper in the following paragraphs:

Last year approximately a quarter of a billion dollars, or one-fourth of total State motor vehicle collections, were distributed for local road and street purposes.

Study of the past 10-year trend in this allocation of State funds reveals that the 1936 allotment was more than double the amount distributed to local jurisdictions in 1927. The percentage of total collections so distributed, however, has increased during that period by only 3 per cent.

The amount of State funds spent on State roads has also increased in this 10-year period, but the increase has been only 42 per cent as compared with the 115 per cent increase in local road apportionments. Moreover, there has been an actual decrease of 17 per cent in the share of total State taxes so used. This discrepancy appears to be a result of a wholesale use of funds for other than highway purposes.

The amounts of user taxes going to local units of government vary widely from State to State, as do the methods upon which such distribution is based. In 1936 five States made no allocations to local roads, while one State distributed two-thirds of all motor vehicle receipts. Distribution among the local units was found to be based on a variety of criteria, including population, area, vehicle registrations, valuation, tax collections, road mileage, and combinations of these factors. In some States these funds are distributed equally among the local governments.

It has been found that these methods of local road allocations often fail to reflect properly the needs of the highway system as a whole, for an economic distribution of funds requires that money be spent according to the needs of traffic, expressed in terms of the lowest possible total cost of transportation, which includes not only road costs but vehicle operating costs. In other words, it is not merely total traffic which must be considered, but the concentration of this traffic: the intensive as well as the extensive use made of the highway system. Moreover, since all needed improvements cannot be made simultaneously, funds must be spent according to a priority which will permit the largest reduction of total transportation costs to be made first. In determining this priority it should be remembered that because of the integration of traffic on several road systems, it is advisable to improve the primary system first, since it carries the largest amount of concentrated traffic and its improvement brings about increased travel and increased receipts for the support of local roads.

It has been found that the spending of State funds by local governments is not always to best advantage because it is not properly controlled by the State. In ad-

DISPOSITION OF STATE MOTOR VEHICLE RECEIPTS
To State Highways and Local Roads and Streets, 1927-1936

	Total Funds Distributed	For State Highway Purposes	Per cent	For Local Roads and Streets	Per cent	Total Fund to State Highways, Local Roads and Streets	Per cent
I—Registration Fees							
1927	$301,061,132	$220,645,359	73.3	$ 61,543,245	20.4	$282,188,604	93.7
1928	322,630,025	235,142,906	72.9	66,569,311	20.6	301,712,217	93.5
1929	347,843,543	250,704,624	72.1	73,226,339	21.1	323,930,963	93.2
1930	355,704,860	253,013,603	71.1	74,639,463	21.7	327,653,066	92.8
1931	344,337,654	234,593,379	68.1	79,388,101	23.1	313,981,480	91.2
1932	324,273,510	188,539,140	58.1	83,298,207	25.7	271,837,347	83.8
1933	301,315,447	157,754,844	52.4	75,943,682	25.2	233,698,526	77.6
1934	318,576,965	175,382,722	55.1	84,356,966	26.5	259,739,688	81.6
1935	324,855,135	173,477,594	53.4	87,587,250	27.0	261,064,844	80.4
1936	374,921,000	194,491,000	51.9	98,241,000	26.2	292,732,000	78.1
II—Gasoline Taxes							
1927	$258,966,851	$188,951,526	73.8	$ 61,633,115	23.8	$260,584,641	97.6
1928	305,233,842	225,315,715	73.8	68,562,491	22.4	293,878,206	96.2
1929	431,636,454	318,087,598	73.7	101,961,887	23.6	420,049,485	97.3
1930	494,683,410	359,797,465	72.7	118,247,702	23.9	478,045,167	96.6
1931	537,589,717	381,711,610	71.0	134,318,053	25.0	516,029,663	96.0
1932	514,138,900	336,144,197	65.4	127,220,400	24.7	463,364,597	90.1
1933	519,403,450	314,432,266	60.5	153,777,094	29.6	468,209,360	90.1
1934	565,139,596	333,196,930	59.0	138,338,782	22.5	471,535,712	81.5
1935	615,580,975	348,651,966	56.6	150,546,567	24.5	499,198,533	81.1
1936	683,074,000	389,125,000	57.0	167,255,000	24.5	556,380,000	81.5
III—Total Motor Vehicle Taxes							
1927	$560,027,983	$409,596,885	73.1	$123,176,360	22.0	$542,773,245	95.1
1928	627,863,867	460,458,621	73.3	135,131,802	21.5	595,590,423	94.8
1929	779,479,997	568,792,222	73.0	175,188,226	22.5	743,980,448	95.5
1930	850,388,270	612,811,068	72.1	192,887,165	22.7	805,698,233	94.8
1931	881,927,371	616,304,989	69.9	213,706,154	24.2	830,011,143	94.1
1932	838,412,410	524,683,337	62.6	210,518,607	25.1	735,201,944	87.7
1933	820,718,897	472,187,110	57.5	229,720,776	28.0	701,907,886	85.5
1934	883,716,561	508,579,652	57.5	222,695,748	25 2	731,275,400	82.7
1935	940,436,110	522,129,560	55.5	238,133,817	25.3	760,263,377	80.8
1936	1,057,995,000	583,616,000	55.2	265,496,000	25.1	849,112,000	80.3

Although capable of withstanding a total load of forty-five tons, "Pittsburgh" Safety Highway Guard is resilient enough to "cushion" the impacts of vehicles that strike it, diverting them along the guard rather than stopping them abruptly. • This snubbing action minimizes damage to vehicles and the guard and lessens the probability of injuries to individuals. Enameled white for continuous visibility both night and day, "Pittsburgh" Guard makes any road a safer road for all who use it. • For a summary of the findings of the Pittsburgh Testing Laboratory based on a study of this guard in actual use, write Pittsburgh Steel Company, 1642 Grant Building, Pittsburgh, Pa.

Pittsburgh
Safety **HIGHWAY GUARD**

dition, a complexity of lesser units of government discourages broad improvement programs, co-ordination, and long-range planning. Many local units do not comprise sufficient taxable wealth and highway activities to qualify them as logical highway administrative agencies.

In the search for the proper scope for highway activities it is concluded that there may be a distinction between the highway administrative unit and the economic operating unit: that the former may comprise several of the latter. This principle is recognized to some extent in the relation between the Bureau of Public Roads and the State highway departments, as well as in the division of a State into State highway districts.

Operating units which do not have sufficient taxable wealth and traffic may require consolidation before they are able to perform their functions economically. Among other things there must be sufficient road work to allow efficient utilization of equipment, and sufficient appropriations to permit a competent engineering force.

Two types of counties are recognized: rural and urban. Rural county highway units may comprise large areas for economic highway operations, while the urban county, because of its wealth, population, and traffic, may properly be confined to a small area. Because the urban county is usually part of a larger metropolitan area containing other counties, as well as towns and villages, immediate legislation is needed for effectuating correlated action, both in planning the transportation system of the region as a whole and in detail, and in fixing priorities for improvement programs.

Correction of the weaknesses of highway administrative finance, when left to the discretion of a large number of local governments, has been attempted by consolidation of road units, particularly by the transfer of local roads to State control. In the past 6 years, 21 States have taken over 172,000 miles of local roads, constituting a 64 per cent increase in State mileage during that period. Four States have eliminated all locally administered rural highways. As regards the other administrative setups, 26 States have State and County organizations, 6 have State and Township units, and 12 have three systems: State, County, and Township.

Transfer of local roads to State control have brought about a shift of the road burden from land to motor vehicles and from local government to the State.

▼

Method of Constructing Track Crossing Using Grouted Stone Ballast

A crossing installation that differed from the conventional in that it embodied the use of grouted stone ballast, employing the vibratory method, constructed at Cambridge, Mass., for the tracks of the Boston Elevated Railway Co. and the Boston & Albany R. R., was described by Fred Ogden, Sales Manager, International Steel Tie Co., in the report of the Joint Committee on Street Railway Track and Pavement Construction, presented at the recent convention of the American Road Builders Association.

First, the old frogs and ties were removed and new frogs and wood ties placed in position. The frogs were of built-up rail construction, with 1 in. supporting base plates. The 2½ in. clean stone was then air-tamped under the ties and steel base-plates, bringing this first course of stone up to the base of rail.

A 1 to 1 sand-cement, grout of a "thick cream" consistency delivered by transit-mix trucks was then poured into the squares formed by the crossing. The crossing was then vibrated by special vibrators attached to the rail heads, which caused the grout to completely penetrate this first course of stone ballast. That penetration was complete, was proven by digging into the ballast at this time.

A second course of 2½-in. stone was then placed to within 2½ in. of the top of rail, and the grouting procedure repeated, the vibrators being kept in operation continuously during the pouring of grout.

A very distinct change in the solidity of the crossing was noticed during this second stage as the action of the vibrators caused the grout to flow into and fill all the openings and voids in the crossing frogs and between the rails, angle bars, and plates.

Vibration was continued until the crossing would take no more grout. The top surface was then broomed off and roughed slightly to receive asphalt paving.

Traffic on both electric and steam road was maintained during this work.

The advantages obtained by this method were that the wood ties and base-plates supporting the crossing could be solidly tamped on stone ballast, to carry traffic during the grouting period. The use of vibration insured the complete filling of all the voids in the stone ballast and in the crossing frogs. It also formed a positive grout-bond between the crossing steel, the wood ties and the stone ballast, resulting in a unity of structure, heretofore unobtained.

▼

Revised Edition of Manual of Steel Construction

Keeping pace with the improvements in material and design, the American Institute of Steel Construction has issued the third revised edition of the Manual on Steel Construction. This manual has been a guide book for engineers and constructors for the past ten years.

The third edition contains much new data indispensable to engineers, architects and others interested in the design, fabrication and erection of structural steel for buildings and bridges, the most noted of which is the complete revision of all the tables based upon the standard unit stress of 20,000 lbs. per square inch.

The new data included in the third edition are:

1. Revised A. I. S. C. Standard Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
2. Revised A. I. S. C. Code of Standard Practice.
3. Safe Load Tables based on the specified basic unit stress of 20,000 lbs. per square inch. Many of the building codes of the larger cities have already been revised to this unit stress and it is expected that most of the others will promptly do the same.
4. Revised Section Modulus Tables, enlarged to include standard beams, wide flange beams, miscellaneous beams and standard channels.
5. New Section Modulus Table for Plate Girders.
6. Revised Standard Connection Angle Tables, enlarged to include ¾ in. as well as ⅞ in. rivets.
7. Revised specifications covering mill cambering of beams.
8. A table of Dimensions, Weights, Properties and Tolerances for a very complete range of Structural Tees.
9. Revised Standard Fusion Welding Symbols of the American Welding Society.

KOEHRING

Dumptors **in sand and gravel plants are daily proving their efficiency and economy as highly flexible material hauling units. Three speeds, forward or reverse, front end instantaneous dumping and short turning radius are important features for high speed travel and easy spotting in restricted plant operating areas.**

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3026 WEST CONCORDIA AVENUE, MILWAUKEE, WISCONSIN

British Studies of Skidding

ONE of the most interesting sections of the 3rd annual report of the Road Research Board, issued last month by the Department of Scientific and Industrial Research of Great Britain, deals with studies of the problem of skidding. A "finger print" method was used to study the textures of the surface of a road and its relation both to resistance to skidding and to its wearing properties.

In obtaining the prints, a portion of the road surface is inked over and a perfectly smooth tire is rolled over the inked road. The tire is then transferred to a piece of white paper and an exact record of the texture of the road surface with which the tire has been in contact is obtained. The report states that the skidding characteristics of road surfaces are largely determined by the total area of contact between the tire on the road and the number of isolated individual points of contact in this area. These small isolated areas must be surrounded by channels of such a size that when the road is wet the liquid on it can escape through them as the tire passes over. If the channels are too small the individual areas will, in fact, merge into one another and the surface will behave as a smooth one. The report points out that the requirements for non-skid tires are similar namely as large a bearing area as possible is cut by many small grooves to form a large number of individual contact areas.

An examination of the texture prints taken from roads known to be very slippery, the report continues, has shown that on these surfaces the tire makes contact with the road over almost the entire area of the ellipse of contact, while the number of individual contacts in this area is small. Prints from roads having high sideway force coefficients showed that the area of actual contact of tire and road within the ellipse of contact was appreciably less, while the number of individual contacts within the eclipse was much higher. Another application of the road texture print is to study the change in the slipperiness of roads at different seasons of the year. It is believed that these depend largely on the changes of the surface texture of the road. Apart from having a direct bearing on road slipperiness texture prints are of value in enabling the wear and other changes taking place in the surface of road carpets to be recorded and followed.

During the year the motorcycle and sidecar equipment developed at the Laboratory for studying the slipperiness of roads has been employed for skidding tests on a number of special surfaces. Measurements of the skidding coefficients were made on a length of cast iron paving consisting of triangular blocks each side being 11 in. long, with rows of studs laid at right angles, to the direction of traffic. It was found, the report states, that these comparatively large smooth areas did not provide the effect of a coarse textured surface, and the skidding coefficient measured on a wet road fell from 0.3 at 5 miles per hour to 0.26 at 30 miles per hour. Generally speaking, according to the report, a surface giving a coefficient of 0.5 or more at 30 miles per hour can be recorded as safe, whilst a value of 0.2 or less indicates a surface which may give rise to dangerous conditions. The report calls attention to the low value of the coefficient in the cast iron paving experiments at low speed. This it is stated may be attributed to the self-lubricating properties of the surface. Experiments were also carried out on wood paving consisting of ordinary blocks which had a small quantity of gravel pressed into the surface. These gave values of coefficient falling from 0.63 at 5 m.p.h. to 0.23 at 30 m.p.h. Some new paving in which the blocks were grooved either at each transverse joint or at every alternate joint was laid in the same street, but it was found that this treatment did not increase the resistance to skidding of the surface. On old wood block surfaces laid in the same street and tested at the same time, the coefficients at 5 and 30 m.p.h. were 0.32 and 0.13 respectively.

Tests on a number of granite block surfaces appear to indicate that grouting between the sets with cement mortar instead of bituminous material increases the resistance to skidding. Typical values of sideway force coefficient at 10 and 20 m.p.h. on the same road were 0.41 and 0.27 for cement mortar grouting; and 0.24 and 0.20 for bituminous grouting. The latter surface again exhibits self-lubricating properties, *i. e.*, low values of coefficient with a small speed effect. Hitherto the study of skidding has not been made at speeds greater than 30 miles per hour. The use of a new high-powered machine, however, now enables tests to be made up to 50 miles per hour. In certain cases the results of these tests have been rather unexpected. With most surfaces the coefficient tends to reach a steady value between 30 to 50 miles per hour. In others there are indications that the value of the coefficient is continuing to fall, and therefore the risk of skidding is greater. In view of this plans are in hand for carrying out skidding tests at even higher speeds. Specimens of mud taken from road surfaces giving very low skidding coefficients are being studied in the laboratory and the lubricating properties of these muds compared with those of water. Thus an attempt is being made to determine the contribution of various types of mud to the slipperiness of the road. The report briefly discusses the question whether the mud films on a road during fog produce a specially slippery road surface. "Any dust falling on the road from vehicles," the report states, "and any material abraded from the road or squeezed out of hollows in the surface by tire action, is held on the damp road and the solid content, and hence the viscosity, of the film steadily increases throughout the fog. The resulting lubricating film of high viscosity would be expected to increase the slipperiness of the road surface. This film will persist until rain falls or the road surface dries. Any soot particles deposited from the fog will add to the mud already on the road increasing its amount and probably its viscosity. It is possible in addition that this very finely divided carbon may possess specific lubricating properties which will further increase the slipperiness of the mud film to which it is added."

Traffic Over Grossgleckner Alpine Highway

Final figures just published regarding the use of the Grossgleckner Alpine highway during 1937 indicate that during the 184 days in which it was open, 148,000 persons were using the road as against 146,000 in 1936. While the number of Austrians using the road since its opening declined from 87,000 in 1935 to 74,000 in 1936 and 33,000 in 1937, the number of foreigners increased from 44,000 to 72,500 and 95,000 in the respective years. In 1935 and 1936 the largest number of visitors came from Czechoslovakia, namely 12,000 and 16,000, while in 1937, Germany supplied the largest contingent with 37,000 visitors. A remarkable change was noticed in the kinds of vehicles using the road in 1937 as compared to 1936, as the number of passenger cars increased to 26,600 from 24,000 in the preceding year, while the number of busses declined to 4,100 from 5,100. There was also a larger number of motorcycles, namely 4,800 against 4,300, but bicycles declined to 6,900 from 7,700 in 1936. Toll receipts in 1937 amounted to $120,000 or the same as in the previous year.

Presenting the NEW Bucyrus-Erie 29-B

ONE-YARD

SHOVEL • DRAGLINE • CLAMSHELL • CRANE • DRAGSHOVEL

FAST, powerful, compact, the 29-B adds an important new machine to Bucyrus-Erie's world-famous line of modern excavators. High-speed digging, swinging and dumping are synchronized in the 29-B for a smooth cycle with fast acceleration, quick stops and accurate control. "Speedlined" power rides directly to the dipper teeth on anti-friction bearings through a straight-line gear train and two-part hoist. Longer upper boom section and big boom-point sheaves give better digging angles; longer rope wear. A simple, direct-action chain crowd insures a positive, powerful thrust that cuts big bites from the bank. Through the new type center pintle with special thrust washer, the propelling shaft delivers ample power for quick moves. This up-to-date one-yard winner is a machine worth knowing — write today for detailed, illustrated specifications.

Gasoline, Diesel or electric power. Shovel uses 1-yard welded, cast V-front, inserted-tooth, curved door dipper. With standard boom combination at 45°, maximum cutting radius 31'6"; clear dumping height 17'6"; working weight 65,000 pounds. High-speed independent live boom hoist available. Crane rating at 12' radius is 31,000 pounds. Draglines and clamshells usually use 1-yard buckets and booms 40 to 55 feet. Electro magnet for crane available.

BUCYRUS ERIE

BUCYRUS-ERIE CO., SOUTH MILWAUKEE, WIS., U. S. A.

Excavating, Drilling, and Material Handling Equipment

Manufacturer and Dealer Prospects for 1938

Report of William M. Parrish, President of the Manufacturers' Division of the American Road Builders' Association and Sales Executive of the International Harvester Co. to the Annual Meeting of the Manufacturers' Division, Jan. 19, 1938

WE are midway in our 35th Annual Convention and Road Show and it is beyond all doubt the best yet. Considering the records established by this convention and show in other years, that is really saying something. We have every right to be proud of our achievement, for this road-building exposition has become an annual event of truly national importance. Permit me, then, to congratulate every one of you on this year's exhibit.

The quality and size of this year's show and the enthusiasm we have put into it speak eloquently of our faith in our own industry and its prospects for 1938. Here this week in Cleveland we have signalized our determination to push ahead.

The construction industry, in which we play a leading part, is the nation's No. 2 industry, second only to agriculture. As a very large factor in this No. 2 industry we have an obligation of leadership to fulfill, and I am happy to say we have from year to year demonstrated our capacity for meeting that responsibility.

The livelihood of four million people is directly tied in with automotive transportation and adequate automotive transportation demands good roads. In building and distributing road-building machinery we have contributed basically and broadly to the fulfillment of that need—and as a result we have a national highway system unmatched in any other country. The extent to which good roads and automotive transportation have furthered the nation's commerce is immeasurable, and what that has meant to the economic advancement of all communities is incalculable.

In my opinion we as an industry have good reason to look forward with optimism. Our industry enjoyed excellent business in 1937 and it should do so in 1938. However, if the coming year is to equal or better last year, I do not hesitate to say that it will require a great deal more effort on our part than was demanded of us during 1937.

Our job in the coming twelve months, as I see it, will be primarily a job of selling. The sales are there for us, but we will have to work considerably harder to get them. The men who represent us in the sales field are not going to make better records than last year without putting all they have into their work.

I believe it is self-evident that sales resistance will be stronger this year, but it appears to me that it will be a psychological sales resistance rather than a lack of either the desire for our products or the ability to buy them. I base this statement principally on the fact that our sales volume is always largely concerned with the state of mind and the supply of money and credit in the rural communities. The state of mind in these communities is and will be, I concede, influenced by that of the country at large. Therein we have the only barrier to hurdle, for the purchasing power and credit of those identified with agriculture have seldom been better than they are now.

That assertion is borne out by the statistical facts.

Two A.R.B.A. Leaders

William M. Parrish, President Manufacturers' Division (Right). W. P. McDonald, Former President of the Association (Left).

Reports of the United States Department of Agriculture on 1937 farm income support it. Bank deposits in farm areas show it. Careful surveys back it up. Farm buying power remains at high levels and will stay there for at least several months regardless of what may follow in the later months. Not in a great many years has the farmer gone into a new year with a larger reserve of buying power than in 1938. He received about 8½ billion dollars last year, and a huge backlog of that sum has been carried over into 1938. Entering 1938, the farmer has nearly a billion dollars more to spend than he had when he entered 1937.

The farmer is in a position to buy for his own individual purposes and that materially influences his attitude toward the expenditure of funds in his community for advantages to his community, and all of us here well know that no community projects are closer to the heart of the farmer than good roads.

This road show demonstrates impressively the progress we have made in designing and manufacturing better road-building machines and better power units for those machines. We have notably improved products to offer. There is the desire and need for our products. Our job in 1938 will be that of turning these factors into sales. I know we can do it.

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DESIGN OF CAMP STOVES AND FIREPLACES.—A publication on camp stoves and fireplaces for recreational areas has been prepared by the U. S. Forest Service in an effort to bring together the best information available at the present time. The discussion applies primarily to the problems presented in the camps and picnic areas in the national forests; but it may apply equally well to many other types of recreational areas. It should be valuable to highway engineers who occasionally supervise the construction of recreational facilities in connection with roadside development. The book is profusely illustrated with 30 plates, each containing several sketches. "Camp Stoves and Fireplaces" may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for $1.50 per copy (in buckram).

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PENNSYLVANIA TAKES OVER 2,600 MILES OF STREETS.—The highway department of Pennsylvania on Jan. 1 accepted approximately 2,600 miles of township, borough and city streets, relieving them of the cost of maintenance. Transfer of the additional mileage was authorized by the 1937 legislature. It increases the state highways system to a total of more than 40,000 miles.

A source of road steel supply

that you can bank on

WHEN you place an order for road steel with Bethlehem you can forget about steel—it will be there when needed. The Bethlehem Road Steel Service handles every order as a unit, plans shipments according to working schedules and gets road steel to the job in plenty of time. Before you start your next contract, wire or phone the nearest Bethlehem district office for details on Bethlehem's Road Steel Service. It's sound insurance against the possibility of having to pay heavy penalty clauses because road steel isn't on hand when you need it.

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BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

ROPE SERVICE RECORDS HELP CUT COSTS

TIME was when wire rope was universally considered a "minor" item of equipment. For two reasons: first, the cost of two or three hundred feet of wire rope was so small in comparison with the investment necessary in a power shovel, dragline or skip-hoist that just out of sheer relativity the rope seemed of minor importance. Second, all wire rope was pretty much the same. It was a staple (and good) product regardless of who made it, with the result that depending upon the engineering skill with which the wire rope salesman (or buyer) specifies the size, grade and construction of rope to be used for a given application, all ropes were fairly uniform in the service they gave.

Within the past dozen years or so, however, manufacturers have learned how to preform wire rope. And the preforming process so completely relieves wire rope of internal torsional stress, leaving the completed rope relaxed, limber, and with far more balanced strand tension, that for many applications preformed wire rope is far superior to non-preformed. Indeed preformed wire rope invariably gives so much longer service that operators in all fields have had the matter of comparative wire rope service forced upon their attention. After using one or two preformed ropes, then switching back to none-preformed, the wide variance in service made the operators acutely conscious of the frequency of machine shut-downs brought about by the ordinary wire rope's aptitude for early failure.

And machinery shut-downs *can* be extremely costly. The contractor who has a big excavation job on hand painstakingly routes and times his trucks in such a way as to keep the power shovel or drag-line constantly at work. And as nearly as possible he also spaces his trucks so that they receive quick attention on the part of the shovel. It is this carefully arranged schedule that is completely deranged when a wire line breaks and the shovel is down. Trucks pile up—with their drivers idle, all for want of a few dollars' worth of rope.

Since the advent of preformed wire rope, more and more contractors are learning the wisdom of keeping accurate service records of their wire lines. Only with such records can they know exactly which rope, not only in the matter of make but more especially in grade and construction, is best fitted for his particular application. Only with such records can he check up on the efficiency of the machine operator and determine whether or not his wire lines are being abused as well as used.

Preforming, now universally applied by all wire rope manufacturers, has shown the alert contractor that wire rope is an extremely important piece of equipment. He now knows that on it there frequently depends the production of a costly machine and costly man power. Many contractors are now using various systems for keeping a record of their wire rope service. But in this as in everything else, the secret of continued success lies in the simplicity with which such records are demanded of the machine operator or foreman. One contractor has developed a very simple, yet very effective, record form printed on a card which is tacked up in the machine cab. The accompanying reproduction of this service record card shows it capable of keeping track of the service of two ropes. When filled, these cards are turned into headquarters where the information is transferred to a permanent "Service Report Ledger." And it is the gradual accumulation of records in this ledger which gives the management an opportunity to specify the best possible rope for a particular application, to correct time leaks here and there, to encourage more frequent inspection of both ropes and sheaves, and to cut costs all along the line.

WIRE ROPE SERVICE RECORD

Equipment Operated by.....

In What Service:.....

Equipment Description of.....

Condition of Sheaves.....

Rope Diameter..... Construction.....

.....

Grade..... Lay.....

Record of..... Rope

Date On..... Date Off.....

Work Accomplished.....

.....

Lubricated (Dates).....

Remarks.....

.....

Record of..... Rope

Date On..... Date Off.....

Work Accomplished.....

.....

Lubricated (Dates).....

Remarks.....

.....

Form for Recording Service of Wire Rope.

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234,231 RAILROAD-HIGHWAY GRADE CROSSINGS IN U. S. —The Inter-State Commerce Commission's latest report shows that there were 234,231 railroad-highway grade crossings on Class 1 railroads of the United States as of Dec. 31, 1935. It further shows that in 1935 there were actually eliminated 2,071 crossings, and that there were actually added 887, or a net eliminated of 1,184.

JUST HOW MUCH DOES CONCRETE SAVE ON SURFACE MAINTENANCE?

THIS unretouched recent photo shows Illinois State Route 125 entering Springfield. It was paved in 1914. Maintenance figures from 1925 to 1936, inclusive, reveal that this pavement, which carried 1650 vehicles per day in 1936, has cost only $67 per mile per year to maintain.

Another example is a 25-year-old strip near LaSalle, one of the first concrete roads in Illinois. Though carrying heavy traffic (4000 vehicles per day in 1936), the *original surface* is still smooth riding and structurally sound. State highway department records show that surface maintenance averaged only $122 per mile per year from 1927 to 1936.

Surface maintenance for *all* concrete on the Illinois state system from 1921 when records began, up to 1936, averaged only $80.64 per mile per year.

* * *

A summary of all available state highway records shows that 49,000 miles of concrete in 21 states have averaged only $103 per mile per year for surface maintenance.

This is conclusive evidence of the consistent economy of concrete—all the more so because, in general, concrete roads carry the heaviest traffic.

Concrete pavements save taxpayers millions of dollars in maintenance. Add this to the savings represented by concrete's low first cost for equal load-carrying capacity, long life, and economy of vehicle operation, and you can see that concrete is an economical pavement under a wide range of conditions.

●

PORTLAND CEMENT ASSOCIATION
Dept. A2-28, 33 W. Grand Ave., Chicago, Ill.
A National Organization to Improve and Extend the Uses of Concrete

EDITORIAL

Cogent Reasons for Not Reducing Federal Highway Appropriations

IN THE December issue of ROADS AND STREETS we said editorially: "But when he (the President) urges drastic curtailment of highway expenditures he overlooks two important facts. The first of these is that the users of the highways pay for that use in special taxes, and that any reduction in governmental expenditures for highway improvement is equivalent to a diversion of the gasoline tax and the like to other uses."

This argument has been taken up by public bodies that are urging congressmen "to present the case to the White House," as illustrated in the following editorial in "The Los Angeles Times" of Jan. 25, under the title Tax Shift Opposed:

"Diversion of State gas tax funds to other than highway purposes has long been vigorously opposed in this community. The insistence of the Los Angeles City Council that money similarly collected by the Federal government in this area should be devoted exclusively to local Federal highway aid is therefore timely and to the point.

"The Board of Public Works, in a resolution upholding the Council's stand, points out that President Roosevelt's proposal to reduce this aid and to use part of the Federal gas tax revenue for general government expenses would affect local highway programs in which this assistance is relied upon. Any such withdrawal of funds, it emphasizes, would greatly handicap State and county officials in charge of highway development.

"The board has asked the Senators and Representatives from California to present the case to the White House. Practically all of the $200,000,000 annually expended by Washington in aiding highway projects in the States, it stresses, is represented by the fund collected as a gas tax and should be so used.

"Diversion of tax revenues collected for various purposes to uses other than those intended has become a habit with the New Deal administration and the public is justified in calling a halt to the practice. Motorists can more or less cheerfully pay the gas taxes so long as they know the money is being used for the construction, reconstruction and maintenance of highways, but patience ceases when they see officialdom planning to turn these funds into other channels."

We urge the readers of ROADS AND STREETS to write to their congressmen opposing reduction of the Federal highway appropriation, and to induce public bodies, such as Chambers of Commerce, to do the same.

Enclose this editorial with your letter, as well as the editorials in our December and January issues.

▼

Stabilization Standard Needed

NOTABLE progress has been made in the past few years in soil stabilization investigations. Indicative tests have been developed which can be made in the laboratory and field that will disclose some of the properties of the soils under study. All soils can be treated in some manner to improve their resistance to lateral displacement but as yet no standard has been set up as a lower limit of what should be considered a stabilized treatment. Soils vary over wide ranges, we know; but just because a poor soil has had an admixture incorporated or a soil combination designed to improve its stability, should not necessarily classify it as a stabilized soil, so far as engineering employment is concerned. There should be established a criteria of tests that will establish a minimum measure of soil supporting power.

As engineers, we establish certain standards for a material to meet before we accept the material for use in engineering structures. In the present development of the status of soil stabilization we have not yet established minimum standards to which a soil mixture must conform before it can be said to be a stabilized soil. Such a standard will enumerate physical requirements based on such items as abrasion, load carrying capacity related to displacement, surface texture, and hardness after compaction. Water permeability and compressibility beyond a certain load concentration will also probably be part of the criteria establishing a minimum standard.

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Federal Toll Roads

FAVORABLE opinion regarding the adoption of a federal system of highways has been increasing rapidly over the past two or three years. It is evidenced by the multiplicity of bills which were introduced into the last regular session of Congress calling for systems of transcontinental highways. The plans proposed contained varied routes and roads for various purposes.

As this goes to press, Senator Bulkley of Ohio is working on the idea from the self-liquidating point of view. The plan he will propose will require an expenditure of about 8 billion dollars for three transcontinental toll highways.

Whether or not the idea is fundamentally sound can be determined from the data collected by the state highway planning surveys. Certainly a federal highway system has much in its favor. Whether or not the toll method of liquidating the cost can be justified will be shown by a thorough technical investigation. Senator Bulkley outlined his plan to the President last week at the White House. He suggested that the toll highways be financed by bonds to be issued by a new federal highway corporation.

Such a plan of bond financing has merit from the point of view of the social security act. Social security taxes are collected on the theory that they will build up a fund from which later to pay old age pensions. The moneys collected cannot remain in the vaults; they must be used for interest bearing investments. What can you think of that would be a better investment for bond money than a federal highway system? A bond is a mortgage, a promise to pay. Transcontinental federal toll highways would be the soundest investment possible for social security taxes and an investment large enough to furnish the backbone of the investment plan. Bondholders would actually have something tangible securing their investment.

Adoption of a system of federal highways would tend toward uniformity of signing, uniformity of patrol, uniformity of maintenance, and a uniformity of highway service. It would provide for a priority system for national defense purposes. The states or other political subdivisions would have no control over these transcontinental unifying routes. Federal funds, exclusively, would be used for them. Senator Bulkley's proposed plan deserves careful investigation.

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The Road Builders' Library has been planned to give in a clear, concise form, the most up-to-date data available. In its six volumes you will find summarized the experience and practical knowledge of some of the most successful highway engineers. It is invaluable as a reference source for your NEW jobs. It tells how similar work was effectively and profitably handled elsewhere—pointing out what the limitations are and how results may best be obtained. It gives you useful calculations already worked out, tables, charts, and other useful data that provides a short-cut to *Profit-Making*.

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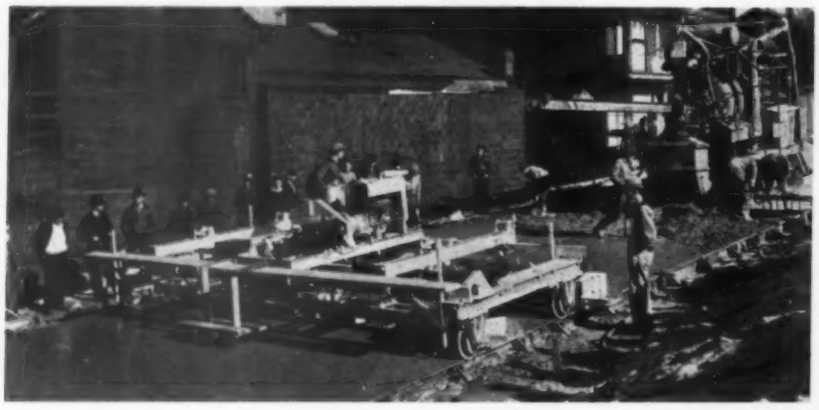
NEW EQUIPMENT AND MATERIALS

Gas-Electric Finisher

A gas-electric concrete paving finisher said to be able to strike off and surface finish 2,000 to 2,400 ft. of pavement per day in 18 or 20-ft. widths, has been developed by Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa. Two rocking surfacers smooth the concrete surface as the machine travels slowly along the road forms. Concrete poured from the paver is leveled off by the same method. A gasoline motor generates power for the electric operating motors. Illustrated is the machine in operation on a 20-ft. concrete roadway being laid down with the aid of new type 9-in. self-aligning road forms having an 8-in. base.



New Finisher in Use in Jerome Ave. Bridge Approach, McKeesport, Pa.

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New Tire for Heavy Duty Construction Operations

The Firestone Tire and Rubber Co., Akron, O., has recently developed and placed on the market a new type of tire especially constructed for the most destructive types of tire operations. The tread and sidewalls of the new Firestone excavator tire are so compounded as to be much tougher. Specially tough, cut resisting rubber plus greater thickness of the tread and sidewalls give added protection necessary to keep most cuts and snags from extending to and injuring the cord body. The shoulders have been made higher to better distribute the load and are wider to protect the sidewalls. The new Firestone excavator tire throughout is heavier and more rugged. It also has added construction features which absorb impact shocks without injury to the cord body. In every detail the excavator tire is specially built to stand the most severe conditions. It may be had in a range of sizes popular with vehicles in the types of service for which it is built.

Truck Equpiped with New Firestone Tires on Excavation Operation in Rocky Soil

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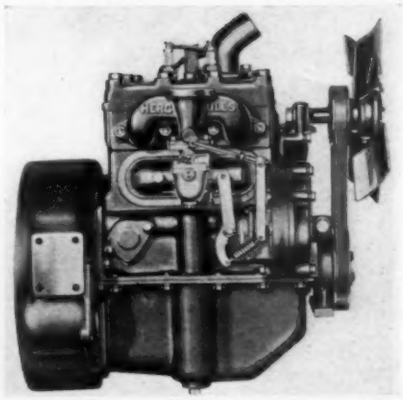
Hercules Adds 2-Cylinder Gasoline Engines to Line

The Hercules Motors Corporation of Canton, O., in announcing the "NX" series engines and power units has added two models of 2-cylinder, heavy-duty gasoline engines and power units to its present line of well known 4 and 6-cylinder gasoline and Diesel engines. The internal dimensions of the "NX" series are as follows:

Model	Bore	Stroke	Displacement
NXA	3	4	56.5
NXB	3¼	4	66.3

These two engines are identical in general design and the majority of the parts are interchangeable, the only difference being in the bore size and the parts affected thereby. The maximum torque of the "NXA" is 39 pounds feet at 1,100 RPM, and the maximum torque of the "NXB" is 46 pounds feet at this same speed. For continuous peak load service both models can be operated up to 1,800 RPM, at which speed the "NXA" develops 12.4 and the "NXB" 14.7 corrected horsepower. To meet present-day conditions, which call for sustained high-speed operation, special consideration has been given to the cooling of the valves, and the usual Hercules practice of cooling the valves through the stems is employed. Updraft manifolds of either the center or rear-outlet-type can be furnished. The number 5 SAE bellhousing is furnished as standard equipment on the engines and the industrial power units, although the number 4 size can be furnished upon request. Full, force-feed lubrication to all main and connecting rod bearings is furnished and the lubricating pump is located in the oil sump and is driven to helical gears from the main camshaft. Oil pressure can be easily adjusted to suit the operating requirements. The crankcase is cast integral with the cylinder block, and carries the crankshaft supported by two main bearings of ample proportion. These bearings are 2 in. in diameter, the front bearing is 1 9/16 in. long and the rear bearing being 1⅝ in. long. Connecting rod bearings are 1¾ in. in diameter and 1⅛ in. long, connecting rods being 6 9/16 in. in length from center to center.



Carbureter Side of New Hercules "NX" Series in 2-Cylinder Engine

▼

New Electric Concrete Vibrator

A new electric motor-driven, internal type of concrete vibrator to vibrate concrete into place as it is poured, has been placed on the market by the Syntron Company, 384 Lexington Ave., Homer City, Pa. The equipment consists of three pieces—an electric drive motor mounted on two small wheels—a variable length of flexible shafting and the vibrating tool, which is immersed in the concrete. The electric motor, which is mounted on small steel wheels, is of the repulsion-induction type and operates on both 110-220 volts, single phase, A.C. It has a built-in gear box with quiet, molded gears that increases the driving speed to 7200 RPM. The flexible shafts are metal

New High Speed Electric Concrete Vibrator

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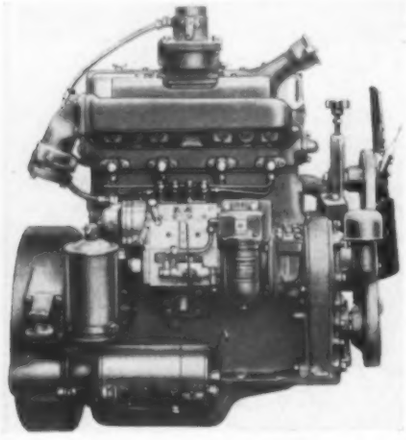
armored and are available in 7 ft. and 12 ft. lengths that can be coupled together to make up to a maximum length of 31 ft. The vibrating tool is available in two sizes—1⅝ in. and 2⅝ in. in diameter and consists of a steel cylinder, inside of which is an out-of-balance shaft rotating at high speed in heavy ball bearings, which sets up a terrific vibration that permeates the mass in all directions.

▼

New Small Diesel Engine

A new 4-cylinder, 4-cycle portable Diesel has been announced by The Buda Co., Harvey, Ill. This new model is the 4-DT-196, and with its addition The Buda Co. now has 11 sizes of Diesels in production, ranging from 20 H.P. to 220 H.P. The 4-DT-196 is the smallest of the Buda Diesel line. This particular model was developed particularly for use in small trucks, small power shovels, and tractors. Model 4-DT-196 has a bore of 3⅝ in., stroke of 4¾ in. and a displacement of 196



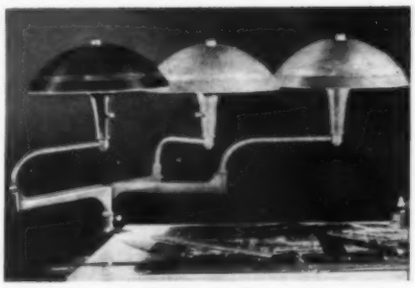
Buda Model 4-DT-196 Diesel

cu. in. The compactness of the engine permits interchangeability with most makes of gasoline engines of comparable power. Typical Buda ruggedness is incorporated in this engine. The crankcase and cylinder castings are integral, and are made of chrome nickel iron. The cylinder liners are easily removable. The crankshaft, which is carried in the block, is 3 in. in diameter, and has 5 wide, precision type main bearings. Connecting rods are 9½ in. center to center. Lubrication is by positive force feed to all crankshaft bearings, connecting rod bearings, valve rocker arms, and timing gears. The "Controlled Tuburlence" Combustion System, used on all Buda Diesels for several years, assures smooth and smokeless operation.

▼

New Lamp for the Drafting Room

The cut made from a triple-exposure photograph illustrates the extreme mobility of a recent lighting innovation for draftsmen's tables, drawing boards, and other expansive working surfaces. The double swinging arm of this lamp can be extended 24 inches in any direction and the lamp held in the desired position with set screws at both turning points. The



New Light Unit

new "Corrected Light" unit was developed by the Greist Manufacturing Co., New Haven, Conn. "Corrected Light" is accomplished with an exclusive luminaire of Celestialite, a triple layer glass, under the metal shade. The three laminated glass layers—blue, opal and clear—whiten and diffuse the light, removing the distorting and harmful yellow rays, minimizing glare, and producing a light comparable to subdued daylight. Color contrasts are intensified under the white light increasing visual acuity by strengthening detail, the manufacturer reports.

The design of this lamp assures a wide distribution of light which, in this model, can be expanded further by the wide range of the swinging arm. Intensities with the recommended 100 watt bulb are said to conform to optical standards for close visual work. Genuine bronze or gunmetal plate with silver-plated trim are the choice of finishes.

▼

Attachment for Eliminating Dust Hazard in Working Dry Roads

During the past year The Gledhill Road Machinery Co., Galion, O., has been experimenting with many different attachments for the Gledhill road shaper which would eliminate the hazard to traffic caused by the cloud of dust present when working a dry, dusty road with any piece of road equipment. As a result an attachment has been perfected which is claimed to completely eliminate this hazard. It is called the dust hazard eliminator, and is fully covered by patents. The attachment is of canvas structure, completely enclosing the shaper. The principle involved is this: "The road shaper is enclosed at the top, both sides, rear end, and front end with an adjustable opening in the front end to let in whatever air is necessary to cause the dust to flow to the rear and escape from the enclosure at

Dust Hazard Eliminator Attached to Gledhill Road Scraper

a point about 3 ft. above the surface, there also being an adjustable opening in the rear end to let the dust escape." The attachment is streamlined, coming to a point at the rear end about 8 ft. back of the shaper. The free air passing along each side has the tendency to close in from both sides on the end, holding the dust in a sort of drift. The air passing over the smooth top is traveling at a higher speed than the air passing through the machine, and the down draft at the rear end holds the dust at a lower level than the top of the machine, which motion of air, together with the current of air sucked in at the rear end, furrows the dust. The machine has been thoroughly tested out in some of the western states where the roads during the summer months are very dry and dusty and has proved very efficient. The attachment is so made that it can be quickly and easily installed on a shaper or dismounted.

▼

A Hydraulic Dirt Worm

A new device for handling pole line construction, which has a reach of approximately 20 ft. from the power unit, has been placed on the market by the Hughes-Keenan Co., Mansfield, O. The

Hughes-Keenan Hydraulic Dirt Worm

auger on the dirt worm is driven by a 6-cylinder radial hydraulic motor, and in ordinary ground will penetrate to a depth of 6 ft. 6 in. in approximately one minute. In case the auger or bit strikes an obstruction, such as a large root or stone, the relief valve on the high pressure line releases the pressure and no breakage occurs. The dirt worm is equipped with three winches—one winch is supplied to operate the auger and motor with motor attachment up and down, the second winch is employed for operating the boom up and down, and the third winch is employed for hoisting and setting the pole. Ample power is provided for the auger, which is transmitted from a hydraulic pump located on the rear of the machine and is transmitted through flexible hose and pipe connections to the motor and returned to storage tank. The leads at the front of the boom are swingably associated so that movement in any direction is free. Poles can be driven at almost any angle, and there is no stress or strain on any of the parts during the boring operation except the normal stress and strain on the motor and auger. The entire outfit weighs approximately 20,000 lb., and can be moved over secondary highways without any trouble with bridges and culverts.

New Light Weight Utility Trailer

A new light-weight utility trailer for the transportation of the lighter types of machinery, such as tractors, compressors, pumps, and small shovels and cranes, has been announced by the C. R. Jahn Co., 165 W. Wacker Drive, Chicago, Ill. This new trailer, which will handle loads efficiently from 5 to 15 tons' capacity, incorporates many new and interesting features. Dual-type wheels of heavily reinforced cast steel roll on oversized tapered roller bearings, and are all equipped with heavy duty full balloon pneumatic tires. Either four or six wheels are available. To expedite loading machinery onto the low flat deck of the trailer, the entire front axle assembly is removable. This is accomplished by a unique arrangement at the front end of the trailer frame, which serves as both a connection and turntable for the front axle. Loading is also made easier by means of a heavy jack screw built into the coupling assembly, which will raise or lower the trailer frame to accommodate practically all jobs with perfect safety. This new front end loading trailer has been carefully designed to conform to all state regulations covering overall widths, lengths, and wheel designs. Additional "extra" features which are now standard equipment on this new model, include adequate loading ramps, lash rings riveted to side frames, reflectors, flag sockets, and heavy duty safety chains.

New Jahn Utility Trailer

▼

New Trukmixers

Blaw-Knox Co., Pittsburgh, Pa., has added a new series of 3½ and 4 cu. yd. Trukmixers to their line of concrete mixing trucks. Major improvements in design, construction, and operating features have been developed and incorporated. In order to provide greater strength and increased resistance to abrasion, manganese alloy steel is used for the mixing drums and the mixing blades. The blades themselves are deeper and the opening between adjacent sections of blades permits faster and more thorough mixing. The accuracy of water measurement has been greatly improved by the provision of a dual system which permits automatic measurement from a full water tank into the mixer by adjustable overflow or, on the other hand, the exact amount of water required for the batch may be automatically measured into the tank. The patented overflow arrangement eliminates errors which are normally caused by the splashing of water during transit or inaccurate measurement while the truck is on a slope. Charging and discharge doors are of machined steel and have machined cast steel door seats. These seats are replaceable. The interior of the mixing drum contains no projections which might cause the concrete to build up. All bearings and rollers for the support of the Trukmixer drum are oversize and positively sealed against concrete and dust. Additional operating safety is contributed by the facts that the gasoline tank for the auxiliary engine is now located on the catwalk rather than over the engine itself, and the controls for the auxiliary engine are so located on the side of the truck that it is no longer necessary for the operator to lean over the transmission machinery to reach these controls.

New Blaw-Knox Trukmixer

▼

New Shank and Bit Punch

A recent development in rock drill sharpening equipment is a new shank and bit punch just announced by Ingersoll-Rand. New features include more convenient location of operating levers, safety guard for punch and improved design, facilitating inspection and reducing breakage of punch pins. This punch, mounted on a sturdy one piece bracket, is adaptable to all recent I-R Sharpeners.

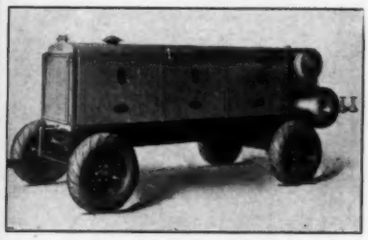
New Shank and Bit Punch

▼

New Mack Trucks

Lighter in capacity and lower in price than any Mack trucks so far produced, two new models, the EE and the EF, rated at 12,000 and 14,000 lbs. gross, respectively, have been put into production by Mack Trucks, Inc., Long Island City, N. Y., The model EE is powered by a six-cylinder engine with 3½ in. by 4⅜ in. bore and stroke developing 75 h.p. at 2,800 r.p.m. Total piston displacement is 253 cu. in. The model EF has a 3⅝x4⅜ in. powerplant which develops 78 h.p. at 2,800 r.p.m. and has a piston displacement of 271 cu. in. The fully counterbalanced crankshafts of both these new models have seven bear-

OK AIR COMPRESSORS



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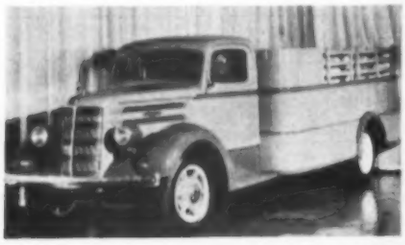
ings and are of drop-forged, heat-treated carbon steel. Cylinders are cast in block with detachable one-piece head and cylinder blocks are of chrome nickel. Both models are of L-head arrangement with exhaust valve seat inserts. The drive on both the models EE and EF is from a dry single plate clutch through a 4-speed, selective, unit-with-engine transmission, a 5-speed transmission direct in fifth being



New Mack Model EE Truck Rated at 12,000 Lbs. Gross

available at slight extra cost. Final drive on both models is of the single reduction type. The EE has two available ratios 5.14 or 5.66, the EF having three ratios of 4.85, 5.83 or 6.80. The model EF also has a double reduction axle available at slight extra charge. All rear axles are full-floating employing Hotchkiss drive. The four-wheel footbrakes of both models are of the internal hydraulic type, total braking area on the model EE being 355 sq. in.; on the EF 384 sq. in. Brakes on the model EF are vacuum booster actuated. Both models have chassis frames of pressed carbon steel with side members 7 15/16 in. deep, 7/32 in. thick and a 3 in. flange. Cross members are five in number, three being of the box girder type. Springs on both the model EE and EF are 42-in. by 2¼ in. in front, 51 in. by 2½ in. in the rear and helpers are 34¼ in. by 2½ in. An exclusive feature of the spring suspension in these models is the use of Mack rubber shock insulators at all spring ends. This feature insulates both body and load against road shocks and also eliminates the necessity of lubrication at spring ends.

▼

New Crawler Hoist

A new crawler hoist, having three hoisting drums, has been brought out by the Harnischfeger Corporation, 4400 W. Na-

P & H Multi-Service Crawler Hoist

tional Ave., Milwaukee, Wis. It is claimed the hoist combines in one machine unusually high lifting capacity with the drawbar pull and mobility of a tractor from which it is posible to work off either side or over the front end. The machine has three forward travel speeds ranging from 1.3 m.p.h. in low gear to 5.2 m.p.h. in high. It has a ground pressure of only 7.6 lb. per square inch. Its live boom is quickly adjusted up and down, enabling the hoist to adapt itself to a wide variety of work. The hoist lifts up to 35,000 lb. with stiff leg. It loads itself on its own automotive type trailer for long distance travel—thus enabling it to see duty from one end of the country to the other in the course of a day.

▼

New Truck Scrapers and Graders

A complete line of new models of underbody truck-scrapers and power-reverse truck-graders, in sizes from 8 ft. to 16 ft. for mounting on all makes of trucks of 1½ ton and up for road and street maintenance work, has been announced by the Willett Manufacturing Corporation, Plymouth, Ind. Many new improvements have been made and the line is more complete than ever. These machines are available for operation by compressed air, hand pump hydraulic and full power hydraulic control. Very little downward pressure on the blade is necessary in order to do effective work. Extra attachments for these machines such as combination curved and flat moldboards on the same machine, special curved blades, special scarifier and roller attachments, special curved moldboards for black-top mix, etc., are available and can be readily mounted and used thereon. The new Willett truck-grader illustrated is a Model T-14 14-ft. combination machine with both flat and curved moldboard mounted thereon installed on a 5 to 7-ton 4-wheel drive truck. This truck-grader not only has full power hydraulic control with continuous running oil pump operated off truck transmission controlling all its operations but is also tilted from side to side and also changes its cutting angle by means of hydraulic controls located in the truck cab. Although the cutting angle is changed hydraulically, a special mechanical device holds it in place when working which is automatically synchronized with the hydraulic reversing mechanism. Some new patents on these machines are already issued and others are pending.

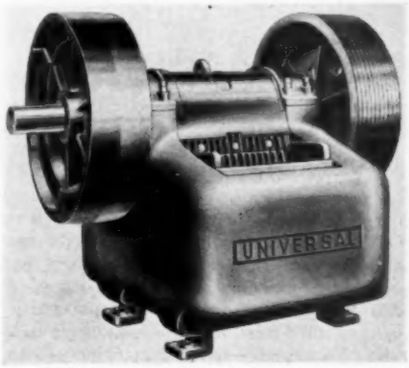
▼

New Device for Rethreading Jackbit Steel

A new development of the Ingersoll-Rand Co., 11 Broadway, New York, is a thread-forging device for rethreading jackbit steel. This method of rethreading, consisting of a set of blocks and a die used in connection with the I-R sharpener, not only produces a thread which is tougher and more resistant to drilling shock but also greatly reduces the time consumed in the operation. Approximately five hours required for annealing machine threads is completely eliminated by this forging method. It is estimated that 20 rods per hour can be rethreaded by the new process.

New Crusher

A new crusher has been announced by the Universal Crusher Co., Cedar Rapids, Ia. This new and revolutionary Universal crushing unit, the manufacturer claims, possesses unusual strength from the streamlined frame, plus weight savings. By reason of greater strength and lightness, the manufacturer states that savings are effected in first cost, in shipping costs,



New 10 in. by 16 in. Universal Crusher

in installation and operating costs. That the appearance of this new unit is pleasing to the eye is well illustrated by the 10 in. by 16 in. Universal crusher pictured herewith. A bulletin just issued on this new crusher, giving complete details, is available from the manufacturer at their office mentioned above.

▼

New Scraper

A preview of the new Model CS-12A 4-wheel wagon scraper of the Continental Roll & Steel Foundry Co., East Chicago, Ind., was afforded visitors at the recent Road Show. While specifications, delivery dates and operating data are not as yet available on this latest addition to the Continental line of wagon scrapers, the illustration herewith gives general details. The Continental Model CS-12A is cable operated and employs pneumatic rear wheels mounted on through axles supported on both sides. Body and apron are of steel

New Continental Model CS-12A 4-Wheel Wagon Scraper

plate of ample proportions, heavily braced; cutting edge is full width and adjustable for any depth of cut. Single-tired wheels are used on the front end, located close to the center post to allow for short turns. Weight has been minimized without sacri-

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fice of strength or length of service life—the entire assembly being of most pleasing appearance. Operating and design details will be available shortly from the manufacturer or Allis-Chalmers Dealers, through whom these equipments are distributed.

▼

New Metal Winterfront for Tractors

A new, airproof, metal winterfront for tractors was on first exhibition as standard equipment at the convention of the American Road Builders Association in Cleveland. A metal shutter replaces the former canvas radiator cover substantially decreasing the cost of fuel necessary to run the motor, by raising the temperature of the engine more quickly and permitting the use of a crude oil distillate after a shorter run on gasoline than with the former canvas front. The metal front also is claimed to increase the running efficiency of the engine by regulating the amount of air entering, thereby holding the engine at the proper temperature necessary for efficient operation for engines using either distillate or only gasoline. By means of a control rod, the operator of the tractor can adjust the shutter of the new front from the driver's seat, ending the necessity of stopping the tractor, getting off the seat and adjusting the cover by hand. Although metal fronts have been used on automobiles for some time, an important feature of this new patented construction is stated to insure absolute closure of the radiator, the suction of the fan itself aiding in closing the shutter blades tightly. This metal front is a product of the Pines Winterfront Co., 20 N. Wacker Drive, Chicago, Ill.

New Winterfront for Tractors

▼

New Lincoln Electrode Holder Weighs Only 14 Ounces

A new arc welding electrode holder, the feature of which is remarkably light for the capacity, has been announced by The Lincoln Electric Co., Cleveland, O. The new holder, designated "Type ST," weighs only 14 ounces and has a current capacity of 250 amperes continuous, equaling that of many type holders weighing 25 ounces or over. The light weight, obtained without any sacrifice of capacity, is attributed to use of formed steel parts, electrically welded. Unique for its light weight, the new holder has a number of other advanced features, most important of which is probably the extremely simple type of connection which assures positive contact and eliminates loose connections, a more or less common cause of overheating in holders.

New Line of Split Power Take-Offs

The Hercules Steel Products Co., Galion, O., has brought out a complete new line of split shaft power take-offs. Three distinct models are manufactured, each in two different sizes. Model D-700 is a direct drive unit without gears. Model T500 is a counter-shaft drive chain unit and Model D-800 is a side drive gear driven unit. The power is transmitted from the D-800 to the side of the truck frame.

▼

New Unit for Pneumatic Placing of Concrete

A complete truck mounted and truck motor operated unit for placing concrete pneumatically has been brought out by the Hercules Steel Products Co., Galion, O. The outfit is a complete unit, installed on a standard current model 1½-ton capacity chassis. The equipment consists of a 105 cu. ft. 2-stage air compressor driven directly from the truck motor by the Hercules split shaft power take-off. A compressor is mounted directly at the rear of the cab, a water tank is suspended immediately to the rear of the compressor, and a mixing tank and cement motor is placed at the rear of the truck chassis. An air hose extends from the air receiver tank to the air motor, which forces the sand and cement through the hose. At the end of the hose is a nozzle attachment. At this nozzle, water under approximately 40 lb. pressure, is allowed to enter. The water hydrates the cement and sand. The cement sand and water, which has been hydrated, is then shot from the nozzle to the point desired.

▼

WITH MANUFACTURERS

N.I.A.A. to Hold 1938 Conference in Cleveland

The National Industrial Advertisers' Association will hold its 16th annual conference in Cleveland, Sept. 21-23, it has been announced by Stanley Knisely, Advertising Manager of Republic Steel Corp., who, as vice-president of the association, heads its committee for conference program and arrangements.

Last September the association surpassed all its former attendance records with a registration of almost 800 at the Edgewater Beach Hotel in Chicago.

F. O Wyse, Advertising Manager of Bucyrus-Erie Co., South Milwaukee, who at that meeting was elected N.I.A.A. president for the current year, characterized the whole year of 1937 as the busiest year of growth and expansion of activities in the association's history, since its formation in 1922.

Three new chapters were added—Toledo, Toronto and Indianapolis—and a dozen different research and development projects were carried on in addition to the separate activities and monthly meetings of local chapters now being held regularly in 15 cities.

Typical of some of these national committee activities was the recent development of publishers' forms for three classifications of business papers, developed to provide more detailed and comparable data for space buyers and including editorial, or qualitative information, as well as additional industrial coverage and circulation data. Another report recently issued covered the influence of local dealers on the buying of space in trade papers.

▼

Timken Engineers Advanced

Following the resignation of Ernest Wooler, Chief Engineer of The Timken Roller Bearing Co., Canton, O., A. L. Bergstrom has been appointed executive engineer to coordinate some of the varied engineering activities of the company. A graduate of the Royal Technical Institute of Sweden, Mr. Bergstrom spent several years with the Krupp organization in Germany. After a number of years in design work in this country, he became connected with The Timken Roller Bearing Co. in 1929 in the Works Engineering Department, advancing to the position of chief works engineer, which position he filled until his appointment as executive engineer of the company. With Mr. Bergstrom's appointment, the company also announced the following promotions in the several divisions: R. M. Riblet to be chief engineer of the Automotive Division, J. B. Baker to be asst. chief engineer of the Automotive Division and chief engineer of the Rock Bit Division. S. M. Wickstein is appointed chief engineer of the Industrial Division, H. C. Edwards will be chief engineer of the Fuel Injection Equipment Division, W. C. Makley will be chief works engineer, and E. J. Reagan, general service manager.

▼

Mark Beeman Appointed Executive Secretary Concrete Reinforcing Steel Institute

By unanimous vote of the Board of Directors of the Concrete Reinforcing Steel Institute on Jan. 5, 1938, Mark Beeman was tendered the post of executive secretary of the institute as successor to the late R. W. Johnson. Mr. Beeman assumed his duties at the institute office in Chicago on Jan. 20, 1938, in association with W. S. Thomson, the technical secretary. Mr. Beeman served as secretary of the institute from its organization in 1924 until the year 1933 and thereafter as manager of the Washington, D. C. office of the Portland Cement Association.

▼

Brooks Equipment & Mfg. Co. Formed

The Brooks-Payne-Osborne Equipment Co., distributors for the Bucyrus-Erie Co., South Milwaukee, Wis, and the Day Pulverizer Co., both of Knoxville, Tenn., have now consolidated to form The Brooks Equipment and Manufacturing Co. This firm has its offices, factory, and warehouses at 408-410 Davenport Road, Knoxville, Tenn.

"A BIG YEAR"

A big year for "FLEX-PLANE" finishing machines, joint installing machines and dowel rod spotters is here. Please place orders as early as possible.

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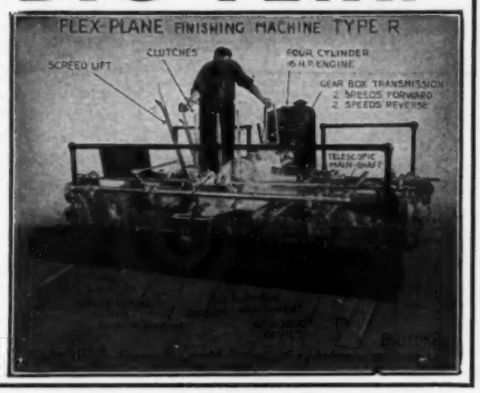
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JAEGER SPEED KING - 7S and 10S TRAILER MIXERS

Trail at 35 m.p.h. on Timkens and pneumatic tires — 5 to 7 seconds loading, 7 second discharge of stickiest dry concrete. End discharge cuts placing costs, pours direct into forms. Get our prices, all sizes 3½S to 56S, latest type Tilting and Non-Tilt mixers.

THE JAEGER MACHINE COMPANY
223 Dublin Avenue Columbus, Ohio

Did you know that—

SO POOR WERE ROADS
IN SPAIN DURING THE EARLY 19TH CENTURY, THAT NO LESS THAN 30,000 HORSES AND MULES WERE REQUIRED TO TRANSPORT 480 TONS OF WHEAT FROM OLD CASTILE TO MADRID. THIS WAS ESTIMATED TO BE 100 TIMES AS MANY ANIMALS AS WOULD HAVE BEEN NEEDED FOR THE JOB ON THE BEST TYPE OF BROKEN STONE ROADS BEING BUILT DURING THE ERA.

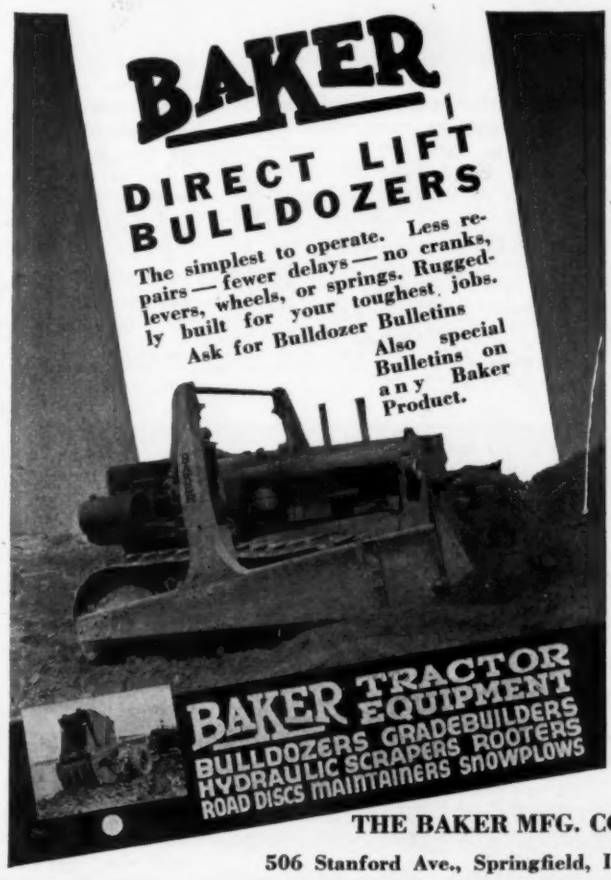
BAKER

DIRECT LIFT BULLDOZERS

The simplest to operate. Less repairs — fewer delays — no cranks, levers, wheels, or springs. Ruggedly built for your toughest jobs.

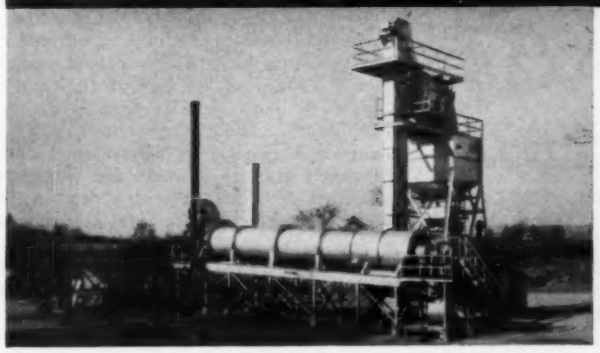
Ask for Bulldozer Bulletins

Also special Bulletins on any Baker Product.



THE BAKER MFG. CO.
506 Stanford Ave., Springfield, Ill.

H&B ASPHALT PAVING MACHINERY



The H & B tower type plant combines portability and large capacity. Built by manufacturers of asphalt paving machinery for over 30 years.

Send for our new bulletin T-247

JOT YOUR NAME on THE MARGIN of THIS AD and MAIL IT to US TODAY.

HETHERINGTON & BERNER INC.
ENGINEERS—MANUFACTURERS
INDIANAPOLIS, IND.

Robie New Manager of F-M Diesel Sales

T. M. Robie has been appointed manager of the Diesel sales division of Fairbanks, Morse & Co., Chicago, Ill. Mr. Robie has been associated with Fairbanks Morse since he returned from World War overseas service in 1919, serving in numerous capacities in the manufacturing and sales division. Since 1932 he had been in charge of Disel sales to resale manufacturers. Previously, he was associated with the New York branch office for one year and the Dallas office for two years, and was employed at the factory on Diesel engine designing, testing and building for nine years. Upon his graduation from the University of Michigan in 1914, where he specialized in the study of internal combustion engines, Mr. Robie was employed by General Electric Co. on locomotive test and on development of high-speed opposed-piston Diesel generating sets for stationary and Diesel-electric railway locomotive application. He operated Diesel power plants in New Mexico for two years previous to entering war service.

T. M. Robie

▼

Changes in Carnegie-Illinois Sales Department

David F. Austin, who has been manager of sales, Chicago district, of Carnegie-Illinois Steel Corporation since November, 1935, succeeds C. V. McKaig as vice president in charge of sales of Carnegie-Illinois effective Jan. 1, 1938. Mr. McKaig was recently elected vice president of United States Steel corporation of Delaware. Other executive changes in the Carnegie-Illinois sales department effective the same date include the following appointments: Thomas J. Hilliard, general manager of sales, succeeding J. Halsey McKown, assistant vice president and assistant general manager of sales, who becomes asssitant vice president of the United States Steel corporation of Delaware. Philip M. Guba, manager of sales of the Chicago district sales office, succeeding Mr. Austin; Francis C. Hardie, manager of sales of the Detroit district sales office, succeeding Mr. Guba; Thomas J. Bray, Jr., manager of sales of the Pittsburgh district sales office, succeeding Mr. Hilliard; F. Royal Gammon, manager of sales of the Cleveland district sales office, succeeding Mr. Hardie. Mr. Austin's entire business career has been spent with United States Steel corporation subsidiaries. After leaving Columbia University in 1920, he spent seven years in the Youngstown district with the Carnegie-Land company and Conneaut Land company. In 1927 he joined the Carnegie Steel company's sales department in the Pittsburgh district and shortly thereafter he was transferred to Cincinnati where, in May, 1931, he became assistant manager of sales. In November of the same year he became manager of sales at Cincinnati. Two years later he became manager of sales of the Pittsburgh district office, and in November, 1935, was transferred to Chicago where he became manager of sales, Chicago district, the position he has held to the present time. Mr. Guba, who succeeds Mr. Austin, became associated with Carnegie-Illinois Steel corporation in March, 1933, as assistant manager of sales at the Detroit district sales office and was appointed manager of sales at that office in March, 1935. Mr. Guba has been connected with the selling end of the steel industry since 1910, having served 22 years with Jones and Laughlin, Donner Steel Co., and Republic Steel Corporation prior to his association with Carnegie-Illinois.

David F. Austin

▼

Willard P. Chandler Dies

Willard P. Chandler, Jr., aged 49, died January 24, at his home, 426 South Linden Ave., Pittsburgh, Pa. Mr. Chandler was chief engineer of the industrial division of the Blaw-Knox Co. and had been in the employ of the company since January, 1929. Before coming with Blaw-Knox he was identified with the Heat Economy Bureau, and prior to that, respectively with Duquesne Steel Works and Clairton Steel Works of the Carnegie Steel Co. He was a member of the American Iron and Steel Institute, the Association of Iron and Steel Engineers, the Engineers' Society of Western Pennsylvania, the Izaak Walton League, the American Museum of Natural History, the Philatelic Society, and the Duquesne Lodge 731, F. & A. M. He was a graduate of the Engineering School, Cornell University, class of 1910.

W. P. Chandler

▼

Bucyrus-Erie Moves San Francisco Offices

The Bucyrus-Erie Co., South Milwaukee, Wis., announces that its San Francisco offices formerly located at 989 Folsom St. have been changed to 390 Bayshore Blvd. Phone Atwater 2341.

Andrews Equipment Service New Representative for Byers

The Andrews Equipment Service, N. W. Broadway and Flanders, Portland, Ore., are now representing The Byers Machine Co., Ravenna, O., on their complete line of power shovels and cranes from ⅜ to 1¼-yd. sizes. W. D. Andrews is manager of this distributorship, and J. M. Robinson is sales manager.

▼

Pioneer Gravel Equipment Mfg. Co. Changes Name

The Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn., whose business for many years has been engineering and manufacturing equipment for use in mines, gravel pits and stone quarries, on Jan. 1 changed its name to the Pioneer Engineering Works, Inc. The change was made because it was felt the former name had ceased to properly convey to its customers and to the users of its class of equipment the correct nature of its business. This is especially true because of the new products which have been added to its line during the past two or three years, and which are used in other fields of industry. It is felt the new name is broader in scope and will better describe the present character of the company's business. There is no change in the organization, the corporation, or the personnel.

▼

Moffatt Appointed Director of Advertising for U. S. Steel

The United States Steel Corporation of Delaware announced on Jan. 28 the appointment, effective immediately, of Charles R. Moffatt as director of advertising, under C. V. McKaig, vice-president. Mr. Moffatt has been advertising manager of Carnegie-Illinois Steel Corporation since the organization of that company Oct. 1, 1935, and director of exhibits of United States Steel Corporation since July 1, 1935. He moves into his new position after 31 years of service with subsidiary companies, beginning in 1907 in the accounting department of the Illinois Steel Co. at Chicago. He assumed charge of sales statistics and advertising of that company in 1919, and remained in that position until his 1935 appointments. The new office, combining advertising and exhibit activities, will be located at 436 Seventh Ave., Pittsburgh, Penn.

▼

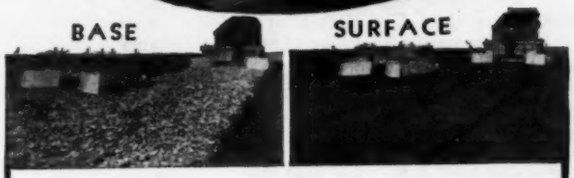
G. E. Braddock Dies

While on a business trip to Chicago, G. E. Braddock, assistant advertising manager of Caterpillar Tractor Co., suffered a cerebral hemorrhage and passed away after an illness of 10 days at St. Luke's hospital in that city. Mr. Braddock was born Dec. 17, 1898. After completing his education, he went immediately into advertising and newspaper work, and was first associated with the advertising department of the Detroit Stove Co. He later moved to Los Angeles, Calif., where he established his own advertising agency, leaving that work to become associated with the San Francisco Call. On July 1, 1928, Mr.

Did you know that—

STONES FOR MACADAM ROADS IN THE EARLY 1850'S WAS FREQUENTLY A FAMILY AFFAIR, THE CHILDREN OF LABORERS BEING FURNISHED WITH SMALL HAMMERS AND PUT TO WORK HELPING THEIR DADS SWELL THE DAILY INCOME.

JAEGER Adjustable SPREADER



Smoothly Spreads Stone, Macadam and Bituminous—1" to 10" of Loose Material, 8 to 11 Ft. Widths.

Lays low cost roads, faster, smoother and with real savings.

JAEGER BITUMINOUS PAVER

power-driven, adjustable 9 to 14 ft., does precision job without forms. Write for details.

THE JAEGER MACHINE CO.
223 Dublin Ave., Columbus, Ohio

Hotstuf
TRADE MARK

ASPHALT HEATERS

TOOL HEATERS
PAVING TOOLS

SURFACE HEATERS — TOOL TRAILERS
POURING POTS, ASPHALT SPRAY PUMPS

Dealers in Principal Cities

MOHAWK ASPHALT HEATER CO.

Frankfort New York

Connery's TAR & ASPHALT HEATING KETTLES

Style "J" 60-75 gallon oil burning kettle equipped with Timken Bearings, solid rubber-tired wheels and truck springs. A fine kettle for maintenance work and the price is low.

All sizes manufactured from 10 to 550 gallons.

Send today for our complete catalog.

3900 North Second St. Philadelphia, Pa.

CONNERY CONSTRUCTION COMPANY

GRAPPLE the "Owen" way

The Owen Grapple, unlike anything heretofore developed, has independently operating tines which grasp an object firmly regardless of its shape.

To "grapple the Owen way" assures a safer operation with a bigger load at every grab and more grabs per day.

Get special illustrated bulletin.

The **OWEN BUCKET** *Co.,* 6070 Breakwater Avenue, Cleveland, Ohio

Branches: NEW YORK PHILADELPHIA CHICAGO BERKELEY, CAL.

Braddock joined the advertising department of Caterpillar Tractor Co. at its San Leandro, Calif., office and removed to Peoria, Ill., when the executive offices were transferred there in 1930. He was named assistant advertising manager in 1932. He was recognized as a national authority on advertising production and layout. Surviving are his widow, a son, G. E. Braddock, Jr., and his mother, Mrs. Anna L. Evans, Los Angeles, Calif.

▼

George Kirtley Advanced by Fate-Root-Heath

George Kirtley, formerly assistant to the vice president of Plymouth Locomotive Works, Division of The Fate-Root-Heath Co., Plymouth, O., has been appointed sales manager of the Locomotive Division. Roy J. Johnson, formerly assistant chief engineer, has been named assistant sales manager.

▼

Worthington Appoints W. A. Meiter Manager of Buffalo Office

Worthington Pump and Machinery Corporation of Harrison, N. J., has appointed W. A. Meiter manager of its Buffalo, N. Y., sales office. Mr. Meiter has been a member of the Worthington organization since his graduation from Ohio State University in 1927, and has served the major portion of his time as a salesman in the corporation's Cleveland territory. In his new position, Mr. Meiter will succeed C. C. Scott, who will now devote his entire time to special work in the Buffalo dstrict.

▼

Western Asphalt Association Holds Annual Meeting

Meeting in Los Angeles, members attending the annual meeting of the Western Asphalt Association reelected Jno. R. Keane President of the Association.

Other officers elected are: Rush M. Blodget, J. R. Pemberton, Vice-Presidents; C. W. Powell, Treasurer; B. H. Maynard, Secretary-Manager. Directors elected are: S. M. Griffith, Geo. R. Daley, A. F. Brough, C. W. Powell and Jno. R. Keane.

Jno. R. Keane, commenting on the meeting indicated that "the most pressing problem of the year concerns the very evident tendency of public officials, both state and national, to reduce the amount of monies appropriated for highway expenditures by direct or indirect diversion of gasoline and motor vehicle taxes.

The Association passed resolutions, addressed to Public Officials, "that the necessity of continued development of our highway system is evident, and that any decrease in Federal Highway Aid allocations is to be deplored and will result in an increase in the tragic record of highway accidents and fatalities; and further that thousands of workers now gainfully employed in highway construction will be without employment."

Suggestions concerning technical and trade practice were discussed and will be forwarded to the American Society for Testing Materials. Through the means of these annual discussions individuals are afforded the opportunity of obtaining an impartial criticism of their proposals.

▼

W. L. Hartley Now Representative for Bycyrus-Erie

The Bucyrus-Erie Co., South Milwaukee, Wis., has recently appointed W. L. Hartley, 7031 W. Wisconsin Ave., Milwaukee, Wis., as their representative for the state of Wisconsin and Upper Michigan.

▼

NEW LITERATURE

Water Well Drill.—The Bucyrus-Erie Co., South Milwaukee, Wis., has released for distribution a new bulletin, number 21-W-2, illustrating and describing the Bucyrus-Armstrong 21-W water well drill. Field action photographs as well as pictures showing the machinery, derrick, controls, and other important parts are well displayed throughout the bulletin. A complete story concerning all the working parts and special advantages and outstanding features of the 21-W is given. A copy of the bulletin will be sent free upon request.

Rock Drills.—A virtual encyclopedia of rock drills and associated equipment, including jackhammers, paving breakers, drifters, stopehamers, wagon drills, jackbits, drill steel, sharpeners, furnaces and blacksmith equipment including jackrod threading devices, calyx and diamond drills, and accessories is presented in a new catalogue, recently published by Ingersoll-Rand Co. Representing one of the most complete tabulations of operating and physical characteristics on drills and drilling tools ever presented in one volume, the catalogue is profusely illustrated with installation and shop views of all the types of equipment presented, and in addition includes eight pages of such useful information as metric conversion tables, friction of air in pipes and hose, horsepowers required to compress given quantities of air to specified pressures, and compressor capacities required to operate from one to seventy drills. Copies of the catalogue, Number 4201, are available from Ingersoll-Rand, 11 Broadway, New York City.

Crusher.—The Universal Crusher Co., Cedar Rapids, Ia., has issued Bulletin 4-A on their new 1938 Model No. 1016 roller bearing jaw crusher illustrating the new type base which, although it is stronger, is lighter in weight, facilitating shipping and moving from one operation to another. This new model features the double action pitman motivated by the overhead eccentric which was originated by Universal. Other design features and specifications are given in this bulletin, copies of which may be had by addressing the maker.

Timely Bulletins for Winter Work.—Engineers are always ready to accept information and data on methods of procedure and technical information on research work by recognized engineer authorities. Realizing this fact, the Calcium Chloride Association has compiled such information and data on two timely subject: (1) Cold Weather Concreting, and (2) Skidproofing Icy Pavements. The first bulletin cites data and information on admixture in various operations with concrete pouring, placing, finishing, and curing. The second bulletin cites methods of employing calcium chloride for making slippery snowy or icy road surfaces skidproof. The information was abstracted from research reports and actual maintenance operations. The bulletins can be obtained by writing the Calcium Chloride Association, 4145 Penobscot Bldg., Detroit, Mich.

Industrial Compressors.—A new bulletin on small industrial compressors and vacuum pumps has been recently issued by Ingersoll-Rand Co. on their "Type 30" line, which ranges in size from ¼ to 15 H.P. The bulletin, number 2118, gives complete rating tables of more than 50 models in this classification, including their physical dimensoins and shipping weights as well as their capacities, pressures, and rated horsepower. Copies of the bulletin are available from the Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

Piling Book and Coffer Dam Calculator.—An illustrated booklet, showing a wide range of steel sheet piling installations, also the shapes and sizes of piling sections rolled, has been issued by the Inland Steel Co., 38 South Dearborn St., Chicago. Technical information given includes chemical analysis of the special steel used for piling sections and brief reports of the installation methods followed in the projects illustrated. Included among these are several pictures made during the building of coffer dam for the Grand Coulee Dam. The booklet offers free to interested persons a Coffer Dam Calculator developed by the Inland Engineering Department. By means of several sliding scales, this calculator shortcuts the time necessary to estimate a piling job. The handy arrangement of the scales and data was developed and has been copyrighted by Inland.

Wire Rope—A 32-page book on wire rope has been issued by the American Cable Division of the American Chain & Cable Co., Inc., Wilkes-Barre, Pa. Profusely illustrated with pictures of the "candid-camera" type, the book shows how to save time when installing new lines; how the preforming process delivers a rope that is pre-broken-in; as well as informative data on how to overcome or minimize such rope-life-destroying elements as fatigue, uneven spooling, whipping, reverse bending, twisting in sheave groves, kinking, porcupining, jerking and abrasion. In addition the new book is specific with respect to individual industries. It gives constructive, helpful information to contractors, oil drillers, loggers, miners, plant superintendents, building owners interested in elevator cable, and other rope users. Copies of the new book are available upon request.

Industrial Compressors—A new bulletin on small industrial compressors and vacuum pumps has been recently issued by Ingersoll-Rand on their "Type 30" line,

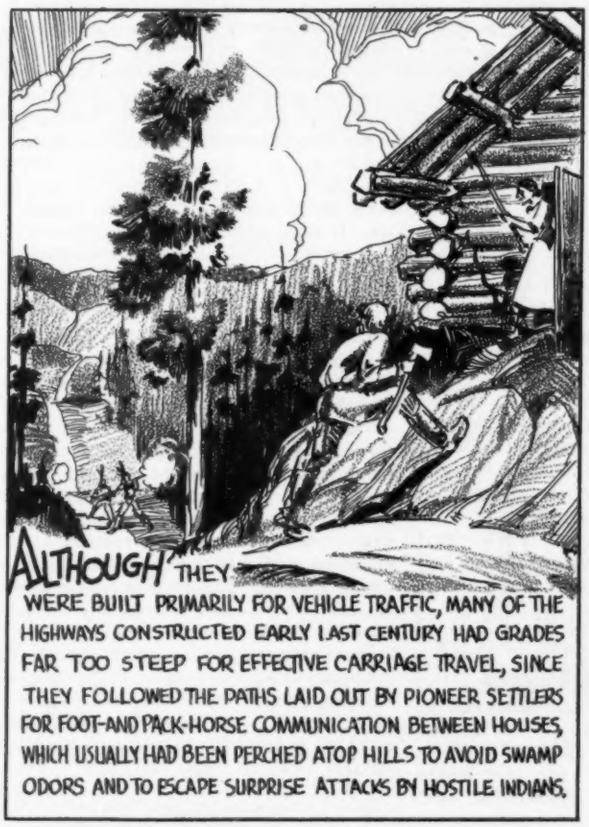
Concrete
VIBRATORS and GRINDERS
Write for Circular on types, sizes and prices
ELKHART White Mfg. Co. INDIANA

LOWEST PRICE
7,000 GALLON JAEGER "HANDY" SELF-PRIMER

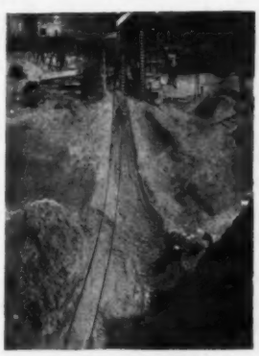
COMPACT, PORTABLE

JAEGER "SURE PRIME" PUMPS
Prime faster, pump full volume, pump more hours. Sizes 2", 3", 4", 6", 8", 10", capacities to 200,000 G.P.H. Send for catalog. The Jaeger Machine Co., 223 Dublin Ave., Columbus, O.

Did you know that—


ALTHOUGH THEY
WERE BUILT PRIMARILY FOR VEHICLE TRAFFIC, MANY OF THE HIGHWAYS CONSTRUCTED EARLY LAST CENTURY HAD GRADES FAR TOO STEEP FOR EFFECTIVE CARRIAGE TRAVEL, SINCE THEY FOLLOWED THE PATHS LAID OUT BY PIONEER SETTLERS FOR FOOT-AND PACK-HORSE COMMUNICATION BETWEEN HOUSES, WHICH USUALLY HAD BEEN PERCHED ATOP HILLS TO AVOID SWAMP ODORS AND TO ESCAPE SURPRISE ATTACKS BY HOSTILE INDIANS.

Slackline Lifting Gravel from River to Screening Plant.



Scraper Moving Gravel from High Bank to Crusher.

Gravel Produced At Low Cost

More sand and gravel is excavated annually in the United States by Sauerman Slacklines and Drag Scrapers than by any other make of excavating equipment.

There is a sound reason for this preference. A Sauerman machine can reach across a wide pit or river or to the top of a high hill and move the materials from this point direct to a screening plant or loading hopper in a simple, continuous, straight-line operation. Other types of excavators require the aid of auxiliary conveyors.

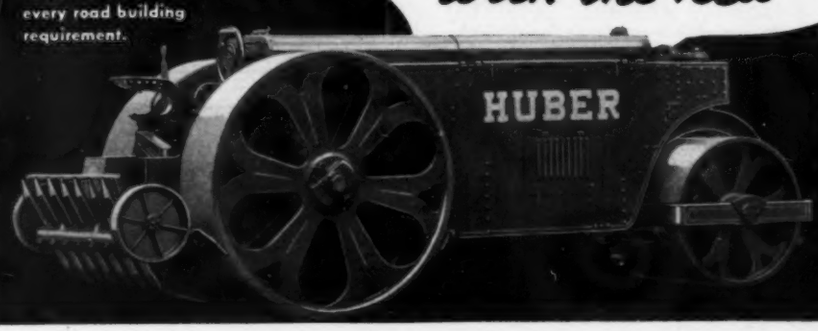
Thus a Sauerman machine is able to produce gravel from any deposit—wet or dry—at a reduced cost per cubic yard.

Several hundred examples of Sauerman machines at work in gravel pits and on other long haul work are shown in Catalog No. 18. Write for a free copy of this book today.

SAUERMAN BROS.
488 S. Clinton St. CHICAGO

All jobs are a "CINCH" with the new **HUBER**

6 Sizes—from 5 to 12 ton. A Huber for every road building requirement.



To fully appreciate this is to put a New Huber Road Roller on that next road job.. Make us prove this statement. Buy by comparison and you will buy a Huber.
Write for Bulletins
THE HUBER MFG. CO.
MARION, OHIO

Buckeye
½-⅝-¾ YARD
Clipper
METERED Vacuum CONTROL
big yardage
LITTLE EFFORT
Here's a machine that piles up big yardage without calling for marathon endurance from the operator.
METERED VACUUM CONTROL speeds up digging by making every swing of the dipper fast and accurate. Finger tip pressure by the operator commands instant response from the machine.
SHOVELS Convertible TRENCH HOES
CLAMSHELLS · CRANES · DRAGLINES
THE BUCKEYE TRACTION DITCHER COMPANY
FINDLAY OHIO

which ranges in size from ¼ to 15 HP. The bulletin, number 2118, gives complete rating tables of more than 50 models in this classification, including their physical dimensions and shipping weights as well as their capacities, pressures, and rated horsepowers. Copies of the bulletin are available from the Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

Contractors' Equipment—Chicago Pneumatic Contractors' equipment is illustrated and described in a new bulletin just issued by the Chicago Pneumatic Tool Co., 6 East 44th St., New York. Included are portable, semi-portable and stationary compressors, sinker drills, demolition tools, drifters, wagon drills, pneumatic tools, concrete vibrators, etc., etc.

Shovels, Draglines, Cranes—The following new literature on Bay City convertible power shovels, draglines, cranes and excavators can be obtained from Bay City Shovels, Inc., Bay City, Mich.: Bulletin 50 containing condensed information and illustrating standard design of all Bay City models from ⅜ to ¼ yd. capacity, both crawler and motor truck mounted. Catalog 10-B. A 10-page catalog with detailed specifications and working range diagrams of Bay City Models 10, 12 and 15 shovels, cranes and draglines for motor truck mounting in capacities from ⅜ to ⅝ cu. yd. Crane capacities from 5 to 7½ tons. Catalog 25-A. An 8-page catalog with detailed specifications, machinery illustrations and working range diagrams of new Bay City Model 25 light ½-yd. convertible shovel, dragline, crane or trench hoe, with a working weight of 25,000 lb. Catalog 65-B. Detailed specifications, working range diagrams and illustrations of Bay City Model 65 1¼-yd. convertible shovel, dragline, crane or trench hoe with a working weight of 70,000 lb.

Wire Rope—A 28-page pocket size book entitled "Wire Rope's Natural Enemies" has been published by the Hazard Wire Rope Division of the American Chain & Cable Co., Inc., Wilkes-Barre, Pa. The book is a sound, constructive treatise on the many things that wear out rope and how either to avoid them or minimize their effect. Sheaves, reverse bends, kinking, whipping, abrasion and many other "enemies" of wire rope are discussed separately and in simple, non-technical language. The book is profusely illustrated with interesting and informative pictures. Of particular interest to all wire rope users is the four-page supplement which deals with the actual money-value to the keeping of accurate records of wire rope service. In addition to explaining how such records frequently indicate ways to increase machine production and make shutdowns less frequent the book carries several "Service Record" forms which the rope user can use in keeping track of machine production and rope service.

Architectural Design of Concrete Bridges—A new publication by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill., deals with the timely subject of architectural principles that apply to the design of bridges. The booklet presents fundamental principles of architectural design, principles that have long been established in the visual arts but restated with particular reference to bridge design. The principles—Unity, Definition and Inflection—are discussed in detail and their application to a number of practical cases of bridge construction is illustrated. Three renderings and many photographs are included.

Distributors—The new distributor of the Kinney Manufacturing Co., 3529 Washington St., Boston, Mass., is illustrated and described in a bulletin issued by that company. The new distributor has an alloy steel tank, a Ford V-8 60 HP. engine, Alford insulation and Westinghouse air brake control on the distributing valves. Other Kinney distribution models are illustrated and described in the bulletin and specifications and various details of the units are also included.

Excavator—Harnischfeger Corporation has issued Bulletin X-31 which gives detailed descriptions of the many new features in the new P&H Model 555—1¼-yd. heavy-duty excavator. Thoroughly describing P&H engineers' use of alloy steels and arc welding in the design of the 555, together with complete information of all of the many new points in design, the Bulletin X-31 is available to anyone who writes the Harnischfeger Corporation, 4400 W. National Ave., Milwaukee, Wis.

Wire Rope Slings and Fittings—A new "Riggers Handbook," just issued by the Broderick & Bascom Rope Co., 4203 North Union Blvd., St. Louis, Mo., contains much information about wire rope slings and fittings. Instructions in the correct designations of sizes and lengths of slings are shown and the proper specification of fittings is given. Directions for splicing and socketing wire rope are given as well as instructions for the selection of guy lines.

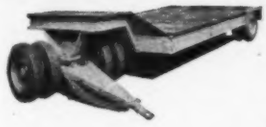
Copper Steel—Attractively printed in copper and black, a new booklet on U.S.S. Copper Steel entitled "A Little Copper in Steel Gives a Lot of Protection," has recently been published by the United States Steel Corporation Subsidiaries. Featured in the new booklet are the results of the latest American Society for Testing Materials' experiment at Annapolis on the atmospheric corrosion resistance of various grades of steel and iron. Applications of U.S.S. copper steel in various industries, including transportation, agriculture, building and construction, air conditioning, culverts, are described. A useful feature of the booklet is a list of fabricated products for which U.S.S. Copper Steel is particularly adapted as the material. Copies of this 16-page booklet may be obtained by writing to United States Steel Corporation Subsidiaries, Box 176, 434 Fifth Ave., Pittsburgh, Penn.

Diesel Engines—Maximum and rated performance curves of the seven current sizes of "Caterpillar" Diesel engines are included in a new booklet issued by Caterpillar Tractor Co. Printed in three colors, the attractive book is a brief resume of the outstanding features of the Diesel engine, as manufactured by Caterpillar Tractor Co. Mechanical features of the engines, as well as a discussion of the precision and fine quality materials that are used in the construction, are also discussed. The booklet is profusely illustrated with model shots and explanatory mechanical cutaways that easily explain the simplicity and exactness of the engines' working parts. Copies of this booklet may be acquired by writing Caterpillar Tractor Co., Peoria, Ill., and specifying Form 4253.

Acco Products—A new convenient reference booklet titled "Acco Products," issued by the American Chain & Cable Co., Inc., comprehensively indexes over 200 different Acco Products; gives a breakdown of Acco Divisions and the products manufactured by each Division; shows a list of sales offices and warehouses for speedy handling of orders. Copy can be obtained from American Chain & Cable Co., Inc., Bridgeport, Conn.

New Holland
Jaw, Hammer & Roll Crushers • Revolving & Vibrating Screens • Conveyors, etc.
Write for Complete Catalogs Box 100
NEW HOLLAND MACHINE CO • NEW HOLLAND, PA

LA CROSSE *Heavy Duty* TRAILERS



The most complete line on the market. Capacities, five to two hundred tons. Four to sixteen wheels. Two to eight axles. They are built to take the heaviest loads safely, and with the least damage to road beds. Write today. Just tell us what you have to move.

THE LARGEST TRAILER IN THE WORLD IS A LA CROSSE !

LA CROSSE TRAILER & EQUIPMENT CO., LA CROSSE, WIS., U.S.A

DIVISION OF LA CROSSE BOILER CO.

THE PURE OIL CO.

PURE THREE POINT LUBRICATION

A COMPLETE LINE OF INDUSTRIAL PETROLEUM PRODUCTS

CHICAGO U.S.A.

Hough Appointed Sales Manager for Murphy Diesel

Murphy Diesel, Ltd., of Milwaukee, Wis., has appointed George P. Hough as sales manager. Mr. Hough's experience is exceedingly broad, combining a valuable combination of sales ability and law. He graduated from the University of Minnesota in 1920 and was admitted to the bar in that year. Shortly after he was employed by Montgomery Ward & Co. in the merchandising department. Some time alter he left Montgomery Ward to go into the manufacturing of portable phonographs, under the company name of Westphone, Inc., where he served as Vice President and Sales Manager. In 1925 he sold his interest in Westphone and became Sales Manager for The Carryola Co. of America in Milwaukee, which he later bought in company with friends, establishing a new firm as Allen-Hough-Carryola Co., of which he was Vice-President in charge of sales. This business was liquidated in 1931 and he was employed by the Charles E. Hires Co. as Chicago Branch manager. For the last few years he has been connected with the construction industry in the manufacture of heavy equipment.

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Civil engineering graduate, Iowa State College, March, 1938, age 24, interested in construction work, six months' construction experience, wishes to contact company needing an engineer. Complete list of qualifications and references may be obtained by writing personnel director, division of engineering, Iowa State College, Ames, Iowa, and C. T. Murray, managing editor, or V. J. Brown, publishing director, Roads and Streets, for recommendations.

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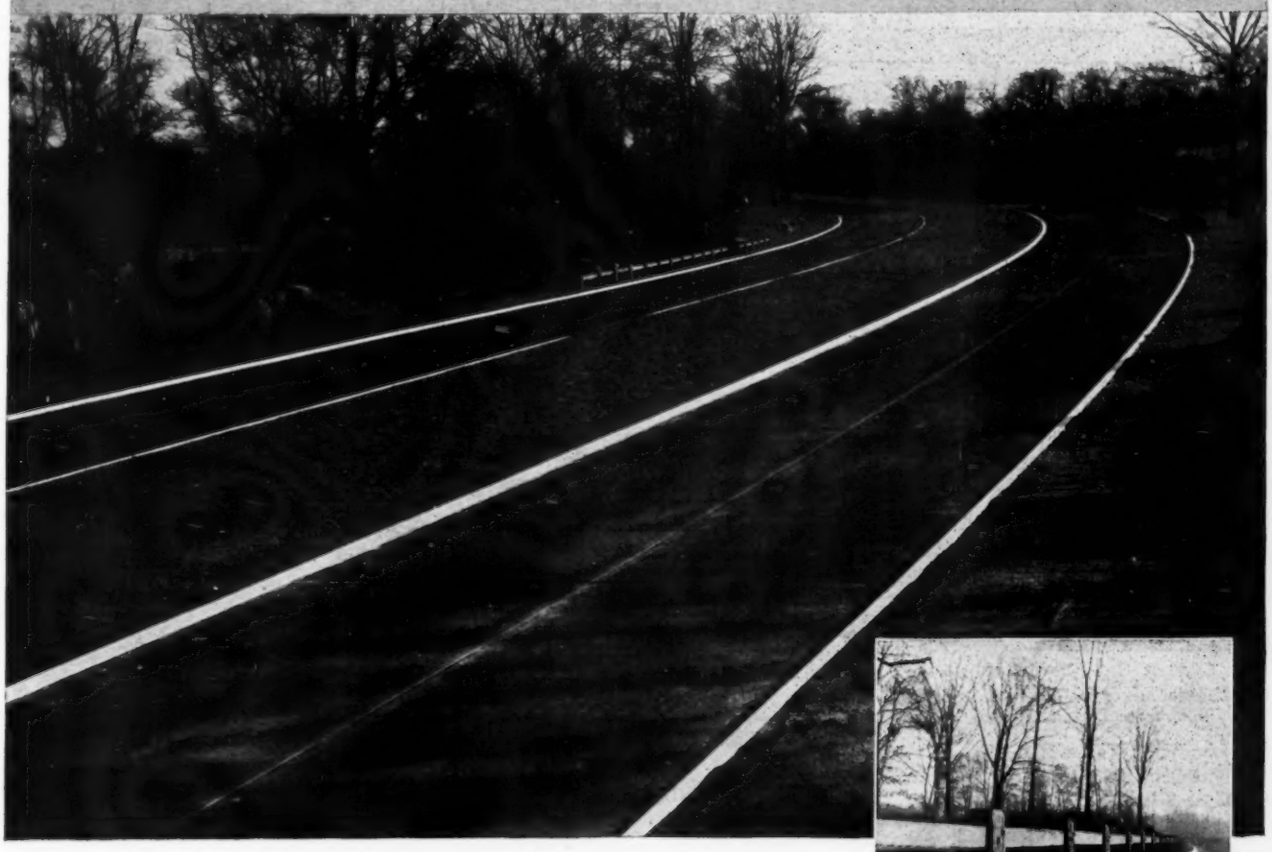

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